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Railways, City Transit, Highways, Bridges, Tunnels and Canals, Water-Works, Artesian Wells, Irrigation, Sewerage and Municipal, Electrical, Contracting, Proposals Open, Manufacturing and Technical.

THE GROSS EARNINGS OF 155 RAILWAYS for the month of January, according to statistics published by the *Financial Chronicle*, amount to $36,773,531 as compared with $34,613,203 for the same month of 1890, an increase of 6.24%. The total mileage operated in 1891 was 90,099 miles, and in 1890, 87,292 miles, an increase of 3.22%. This increase is quite general throughout the country, but is especially noticeable among the roads which receive the spring wheat shipment and among coal roads. Of the 15 roads showing a gain of over $40,000, the Northern Pacific, the Great Northern, the Canadian Pacific and the Chicago, Milwaukee & St. Paul belong to the first class, and stand at the head of the list in the amounts of increase. The coal roads showing the largest gains are the N. Y., Ontario & Western, the Buffalo, Rochester & Pittsburg, the W. N. Y. & Pa., and the Col., Hock. Val. & Tol. Thirty-six of the total 155 show decreases, but generally of small amounts. In several cases, however, the losses are heavy, the most conspicuous being that of the Wabash, $127,057. Considered by groups, the middle Western roads make the best showing, with the exception of the Pacific systems. The Southern lines exhibit less favorable results than heretofore. The Southwestern group also shows a falling off, the Atchison system having a gain of only $132,886. In the Northwest losses are reported in several cases, but owing to the large grain movement the exhibit is on the whole favorable.

THE HARVEY ARMOR PLATE AND CARPENTER PROJECTILE were tested at Annapolis on Feb. 14, with important results. The 10½-in. steel plate was treated by a process of superficial carbonization, invented by H. A. HARVEY, of Newark, N. J. The object of the treatment was to produce a plate possessing surface hardness and yet retain the toughness of good steel. The conditions of the test were the same as for the nickel-steel tests of last September. A 6-in. gun of 35 calibres was used, and 3 Holtzer and 3 Carpenter projectiles, weighing 100 lbs. each, were fired, with 44½ lbs. of powder and a striking energy of 2,988 ft. As the result of the 6 shots, the plate was simply severely cracked. None of the projectiles remained imbedded, and none perforated the plate. The result of the test was deemed very satisfactory, and the showing better than the nickel-steel armor. Of the projectiles, 2 of the Carpenter type were shattered into small fragments with only 4 ins. penetration. One Holtzer penetrated 10 ins., but was badly broken up. The verdict was that the Carpenter shot was equally efficient with the Holtzer, and later tests with 6-in. and 8-in. projectiles confirmed this. The Carpenter Steel Co., of Reading, Pa., was directed to proceed with the manufacture of 6-in. to 12 in. projectiles, for which this company has a $200,000 contract.

THE HENNING GRAVITY TUNNEL RAILWAY, between New York and Brooklyn, is still under discussion. The line is to extend from the vicinity of Broome and Goerck streets, in New York, to the junction of Bedford Ave. and Broadway, in Brooklyn. The track at the stations will have a grade of 2% to start the cars easily, and this will change gradually to a 12% grade on the incline. At a depth of 125 ft. below the starting point the profile changes to a level. A cable moving at 15 miles per hour is run on the upper portions of the incline and this catches the cars and moves them on to the station, when the speed falls to that of the cable as the train moves up the incline. The time of transit is estimated at 1 min. 24 sec. The tunnel is to be double track with one train on each track. With 6-car trains, each car holding 96 passengers and allowing 36 seconds to load and unload, the capacity is set at 17,280 per hour. At the stations there will be three platforms, one in the center for departing passengers, and one at each side for those arriving. At the Brooklyn end the station will be under ground, and elevators will carry passengers to the street level. Mr. O. H. P. CORNELL, 139 Broadway, New York, is Chief Engineer. The enterprise was discussed editorially in our issue of July 19, 1890.

SOME MOGUL FREIGHT LOCOMOTIVES built recently for the Delaware & Hudson Canal Co. by the Dickson Mfg. Co., of Scranton, Pa., have the following dimensions: Cylinders, 18×24 ins.; diameter of driving wheels, 56¾ ins.; diameter of truck wheels, 32 ins.; wagon top boiler, 52 ins. diameter; firebox, 123 ins. long by 33¾ ins. wide; 197 tubes, 2 ins. diameter and 11 ft. 7 ins. long; grate area, 29 sq. ft. Heating surface, 1,355 sq. ft. Driving and rigid wheel base, 14 ft. 2 ins.; total wheel base, 21 ft. 8 ins. Weight on driving wheels, 93,000 lbs.; weight on truck, 13,000 lbs.; total, 106,000 lbs. The tender is carried on 30-in. truck wheels, and weighs 61,000 lbs.; it has a capacity of 3,000 galls. of water, and 5 to 6 tons of coal. The engine is fitted with the American outside equalized pressure brake on the driving wheels, operated with air, and the Westinghouse automatic brake for tender and train.

THE NORTH & SOUTH AMERICAN CONSTRUCTION CO., organized in New York on Oct. 17, 1888, to build 680 miles of railway, etc., in Chili, has practically ceased to exist. A dispatch to the *New York Herald* ascribes the failure of this scheme to a well-defined desire on the part of the Chilian President, Mr. BALMACEDA, to crush out the enterprise, and also to bad financial management on the part of the agents and managers of the company in Chili. Gen. FIELD, of the construction company, finally went to Chili to attempt to reorganize affairs there; but finding this impossible, he sold out the contract to JULIO BERNSTEIN and pocketed considerable loss. By latest accounts, Mr. BERNSTEIN has also failed in carrying out the work, and President BALMACEDA has seized the whole outfit "in the name of the Republic."

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a collision on the Delaware, Lackawanna & Western R.R. Feb. 10, at Elmira, N.Y. An express train struck a wild engine, which was just turning off from the main track to a side track. Both engines were wrecked, and the drivers and firemen were killed. A serious crossing accident occurred Feb. 15, at the junction of the Columbus, Hocking Valley & Toledo R. R. and Scioto Valley R. R., near Columbus, O. A passenger train of 3 cars on the former road ran through a Scioto Valley freight train, striking the tender of the second engine. Three men were injured. It is stated that the brakes on the passenger train refused to act. A rear collision at Rahway, N. J., on the Pennsylvania R. R., occurred last week between a westbound mail train and a fast freight train for Long Branch. The brakeman of the freight had placed torpedoes on the track, but there was not time to stop the mail. The engines of the mail and several freight cars were wrecked, and the wreck caught fire. Two men were injured. A car of a Pittsburg, Cincinnati & St. Louis R. R. train was wrecked Feb. 16 by a rock which fell from the heights at Duquesne, near Pittsburg, Pa. One passenger was killed and three were injured.

BOTH CRANK PINS of a locomotive on the Boston & Maine R. R. broke while the engine was hauling a passenger train near Concord, N. H., Feb. 13. The running gear was wrecked, but the train was stopped before any damage was done. Nobody was injured.

BRIDGE ACCIDENTS are reported as follows: On Feb. 16 a mixed passenger and freight train on the Chester & Lenoir R. R. (narrow gage) jumped the track on a trestle near Newton, S. C., and was wrecked. There were 3 persons killed and 4 injured. On Feb. 16 a collision between two freight trains occurred on the Conneaut Creek bridge of the Lake Shore & Michigan Southern Ry., near Erie, Pa. An engine and 16 cars went into the creek. The new railway bridge at Zanesville, O., the Center Ave. Bridge at Butler, Pa., and several bridges in Pennsylvania have been carried away by the floods.

A SERIOUS COLLISION in the Fourth Ave. tunnel, New York City, was announced on the bulletin boards of the daily papers as we were going to press on Friday morning. The tunnel is the approach to the Grand Central Station. A New York, New Haven & Hartford R. R. train was wrecked. It is reported that four persons were killed and a car burned.

PASSENGER CARS of an improved design, embodying some features of American practice, have been put in operation on the Wellington & Taranaki line of the New Zealand Government Railways. They were built at the government shops. The first-class cars are mounted on trucks, and have a railed balcony along one side, forming a promenade. Half of the body of the car is occupied by a smoking compartment, a lavatory and a private compartment accommodating six persons, which can be engaged for private parties. The remaining part is the saloon, and has on one side a couch or lounge seat, and on the other side double cross seats of American pattern, with reversible backs and wooden arm rests. Beds can be fitted up for the accommodation of invalid passengers. The second-class cars are fitted with lavatories and other improvements. New Zealand timber has been used in the construction of these cars. The gage of the line is 3 ft. 6 ins.

THE PROCTOR TOWER, which, it is said, will be one of the attractions at the Chicago Fair, has been remodeled to adapt it to its possible site. As now submitted the plan shows a tower 1,100 ft. high over a base 380 ft. square. Ten elevators are to be provided, with a capacity of 80,000 persons ascending per hour, and a speed of "700 ft. per minute." In general design the tower is a fair copy of the Eiffel Tower, with the elevators rising vertically from the grounds instead of starting on the inclined legs.

CLAPP-GRIFFITHS STEEL is authorized for use in naval construction, by an official order of Secretary TRACY. This is the result of a long and thorough test made by the Navy Department, and broadens the field of steel production for naval purposes.

A DIAMOND DRILL BORING, 4,500 ft. deep, is referred to by Mr. MOHS in a late lecture before the Society of German Engineers. This hole was drilled in Saxony, near Schladebach, for the purpose of testing a coal formation. Three and a half years were consumed in drilling this hole with a diamond drill. The hole is about 11 ins. in diameter at the top and 2 ins. at the bottom.

THE INCREASE IN LAKE TONNAGE is the subject of the last census bulletin. The additions since 1886 are set down as follows:

	1886.	1890.	*Increase.*
Net tonnage	634,752	826,360	191,708
Estimated value of vessels	$30,697,450	$58,128,500	$37,531,050

Cost of Producing Steel and Steel Rails in the United States and Europe.

The report of Mr. CARROLL D. WRIGHT, Commissioner of Labor, on the cost of producing steel and steel rails in the United States and Europe has been transmitted to Congress. For several years Mr. WRIGHT has been carefully studying this subject through personal inspection and the examination of the books of leading manufacturers by experts. The report covers the cost of production, the rates of wages, time, earnings and efficiency of labor employed, and the cost of living and total earnings of the men employed.

The United States is divided into Northern and Southern districts for the purposes of the report, and the following summary is presented, covering the cost of all elements, per ton of 2,240 lbs. of furnace pig iron, produced in 26 Northern and 24 Southern establishments:

Items.	North.	South.
Establishments reporting	26.	24.
Cost of all materials used	$6,387,022	$5,450,459
Cost of all labor, etc	1,199,918	1,515,995
Cost of all elements	7,587,560	6,966,454
Tons of produce	544,377	647,728
Average cost of all materials per ton of produce	$11.74 4/10	$8.41 4/10
Average cost of labor, per ton	2.20 6/10	2.34 1/10
Average cost of all elements, per ton	13.93 8/10	10.75 5/10

The difference in favor of the South in cost of ore and coal is very great; but this is partially offset by the higher percentage of iron in Northern ores. Presenting the cost in more detail we have:

Items.	North.	South.
Ore per ton, average	$4.40 1/10	$1.51 3/10
Cinder, scrap, etc	2.63 1/10	1.03 1/10
Limestone	.79 8/10	.70 1/10
Coke	3.01 4/10	3.08 4/10
Coal	2.69 5/10	1.56 6/10

Another table shows the total cost of one ton of pig iron from the mining of the materials to the finished product, as follows:

Items.	United States. North.	United States. South.	England.
Establishments reporting	7	5	1
Direct cost of labor, Bessemer iron	$3.70 to $9.44	$4.32 to $7.59	
Officials and clerks	.17½ to .51	.19 to .45	
Supplies, repairs and taxes	1.69 to 5.32	.66 to 1.29	
Transportation to point of use	1.10 to 5.06	.36 to 1.55	
Difference between foregoing actual costs and costs as charged to blast furnaces	1.10 to 5.06	.21 to 2.07	
Total per ton	$13.97 to $16.50	$9.16 to $10.61	$10.21

In another table the cost of producing steel rails is shown, founded on inquiries made at 2 mills in the United States, 8 on the Continent, and 3 in Great Britain, or 13 in all. This matter may be tabulated as follows:

Items.	United States.	Continent.	England.
Establishments reported	2	8	3
Net cost of material per ton	$21.10 / 25.11	$17.69 / 19.88	$16.39 / 18.05
Labor	1.54 / 1.38	1.02 / 4.64	1.36 / 29.54
Total cost	24.79 / 27.68	..... /	18.58 / 21.90

Mr. WRIGHT says that the labor cost in one ton of steel rails should be less per ton relatively in this country than in Great Britain or on the Continent, as American producers dispense with at least one expensive process still adhered to abroad, and the materials used here are purer. As a result of the latter feature the quantity of ore required per ton of rails produced is less in the United States than in many places abroad. The labor in handling the materials to produce a ton of rails is also less.

As proving the above statement, Mr. WRIGHT says that in the Northern district of the United States, 4,137 lbs. of iron are necessary for producing one ton of standard rails. In England 5,127 lbs. of ore are required, and on the Continent about 5,701 lbs. of ore, for the production of practically the same kind of rails.

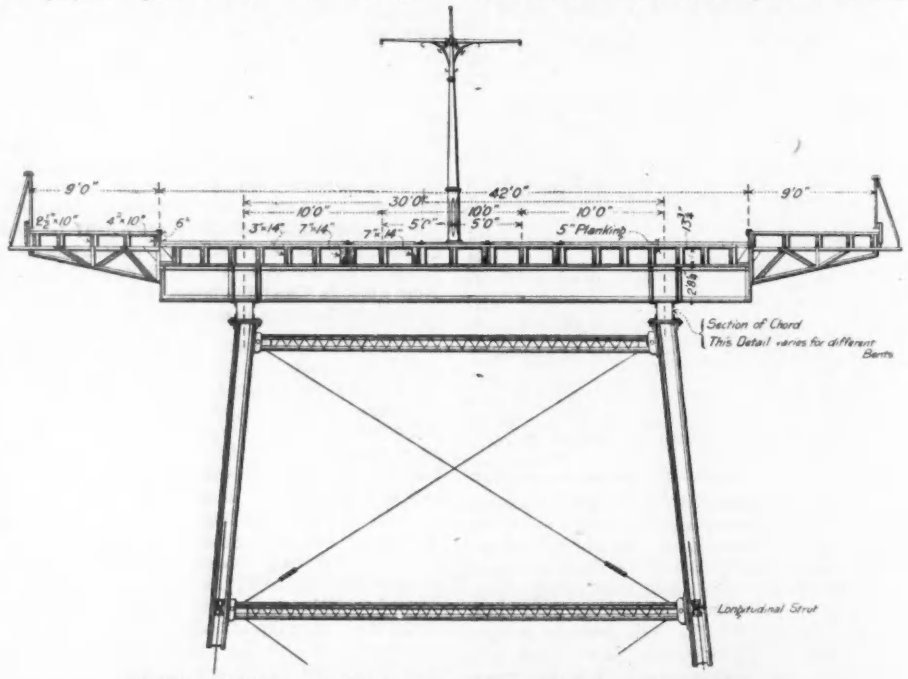
In speaking of the transportation of rails, the report says that heavy freight charges benefit American manufacturers of rails in some cases, and put them at a serious disadvantage at ports where there is water transport for European manufacturers. In illustration of this, the report states that the difference in cost of production of steel rails, in Chicago, for example, and in England, would not exceed $3.50 or $4.00 per ton, and the freight rate of $5.00 per ton from New York to Chicago would be sufficient protection.

But the total expense of water transportation from New York to San Francisco is $11.40 per ton, while the land rate from Chicago to San Francisco is $17.92 per ton. The report presents the market value of English rails at various points in November and December, 1890 as follows:

	Without tariff.	With tariff.
In Liverpool	$25	$25
In New York	25	39
In Chicago	30	44
In San Francisco	25	39

The price of Chicago rails per ton at the same time was $30 at Chicago and $47.92 at San Francisco, giving English rails the advantage of $6.92 per ton over Chicago rails at that point. In this connection, the report states that it is the practice at times to transport rails as ballast, free of charge for freight, between Liverpool and New York.

As to the time workmen are employed, the report gives examples of daily averages in this country and in Europe in pig iron works. The average daily earnings of workmen in the Northern district of the United States varies from $1.47 to $2.03, in the Southern section from $1.22 to $1.34, on the continent of Europe from 64 cts. to 70 cts., and in Great Britain from 62 cts. to 67 cts. In Great Britain and on the continent of Europe, however, the workmen are employed only about three months in a year.



CROSS SECTION OF THE RIVERMONT BRIDGE, LYNCHBURG, VA.

The average earnings per hour for workmen range in the Northern district of the United States from 3 cts. to 18 cts., in the Southern district from 11 cts. to 13 cts., in Europe from 4 cts. to 5 cts., and in Great Britain from 5 cts. to 10 cts. per hour. The reports contain other valuable information as to the relative cost of living.

The Rivermont Bridge, Lynchburg, Va.

The Rivermont Co. owns about 2,000 acres lying northward and partly within the city of Lynchburg, Va. This company is now building a fine iron and steel bridge to connect its property with Main street of the city.

This structure will be 912½ ft. long, between abutments, 60 ft. wide, and 126 ft. above the water of Blackwater Creek. There are 10 spans, as follows: One of 75 ft., one of 100 ft., one of 150 ft., and seven of 62½ ft. The five towers are each 30 ft. sq. on top. The south abutment is peculiar. It is L-shaped and founded on solid rock, benched out of the steep hillside, which makes one corner nearly 60 ft. high while the other is just out of the ground. Some of the footing foundations at the creek are on solid rock, 20 ft. below the surface. The rock on the hillside near the south abutment was blasted to make room for the bottom chord of the upper truss.

The Norfolk & Western R. R. is crossed at a height of 98 feet. There will be 1,700,000 lbs. of iron and steel in this bridge. There are 2,683 cu. yds. of masonry in the abutments and footings. The total cost of bridge, rights of way and approaches will be about $110,600. R. TAYLOR GLEAVES is Chief Engineer and PERCY T. OSBORNE Engineer in Charge.

The Edge Moor Bridge Works, of Wilmington, Del., are the contractors for the superstructure. The masonry was built by John Kelly, Jas. M. Casey and Wood & Co., of Lynchburg. A double track electric railway will cross this bridge and run through the middle of the Rivermont property, which is now being laid out in streets and building sites.

Fenders for Electric or Cable Street Cars.

The annual report of the Massachusetts Railroad Commission, reviewed in another column, contains a monograph on this subject by Prof. GEO. F. SWAIN, Engineer to the Commission. The need of a better fender than that in common use has been before referred to in reports by the Commission; and by an act of the last Massachusetts legislature street cars using any motive power other than horses were required to be equipped with such fenders as the Railroad Commission might require.

Professor SWAIN first discusses the qualities which an efficient fender must possess. It should, if possible, prevent even the front portion of the car from passing over the body of a person struck by it. Something should also be provided which a person struck by the car could easily seize and hold on to, to prevent the car from passing over him. The most important point, however, is to prevent the person struck from falling under the wheels of the car.

It is evident that to meet these requirements the fender must be placed as close as possible to the rails; but on the ordinary four-wheeled car it is impossible to attach a fender to the car body and place it close to the rails on account of the rocking motion of the car. In one of the experiments, four men on each end of a car rocked it so hard that the ends of the platforms had a vertical movement of one foot. Motion as great as this often occurs in running over rough track with the car unevenly loaded. The allowable height of the fender above the rail is also affected by the crowning of streets over bridges, the projecting flange of the rail at curves, sudden changes of grade, and inequalities on the pavement between the tracks.

The author then classifies possible types of fenders as (1) fixed fenders attached to the car truck, (2) fixed fenders attached to the car body, (3) movable fenders, which swing or tip, either automatically or by the movement of a lever by the driver. Besides efficiency in preventing injury to persons struck by the car, a good fender must be simple and cer-

tain of action. It should not be liable itself to cause accident, and should be as inexpensive as possible.

(1) Fixed fenders attached to the truck and projecting to or beyond the front of the car platform are impracticable, because of the tilting motion of the car body, which would cause it to strike any fender deep enough to have reasonable strength. If such a fender projects only a short distance from the truck, however, it may be placed at a minimum distance from the rails and will prevent a body from going under the wheels, though it will not prevent the car platform from passing over it.

(2) Fixed fenders attached to the front of a four-wheeled car must be placed at least 8 or 9 ins. from the track on account of the tilting motion and other considerations mentioned above. This distance is so great that such a fender would be of no practical value, except as affording something for a person to hold on to or unless it could catch and carry a person standing on the track. If the fender be placed under the car platform, it must still be farther from the track than a fixed fender attached to the truck, and there is the added danger that a person struck may be crushed underneath the fender by the tilting motion of the car.

(3) Many kinds of movable fenders may be devised. The form which first suggests itself is a fender pivoted to the truck, extending to the front of the platform and normally raised so that the tilting of the car will not cause it to strike the ground. When an object is likely to be struck by the car, the driver can lower it to roll or slide upon the rails.

The electric cars of the West End Co., which now operates 218 miles of street railway in Boston and vicinity, have thus far generally been equipped with fenders, consisting of a strip of plank 6 ins. wide and 4 ins. from the rail, extending square across the track, about 2 ft. in front of the forward axle. This strip of plank is attached to the truck itself, and not to the car body. In a few cases, wooden V-shaped fenders are placed in front of the square fenders.

Neither of these fenders appeared to be of much account, and experiments on various forms of fenders were undertaken with cars furnished by the West End Street Railway Co.

These experiments consisted in placing between the rails a bag about 15 ins. in diameter, stuffed with blankets so as to bear some resemblance in shape and size to a man's body. Cars equipped with fenders of different styles were run against this obstacle. In some cases a roll of carpeting 6 ins. in diameter was substituted for the bag. These obstacles were placed in various positions on the track.

A large number of styles of fenders were tested in this manner. The results were briefly as follows: Whatever the type of fender tested, if it were not more than 4 ins. *from the ground between the rails*, there appeared to be little danger that the bag would work under it. If this distance was increased to 6 ins., however, the bag would almost invariably work under. The pointed fender has the advantage that at high speeds its tendency is to throw a body to one side. It has the disadvantage that it is more liable to work the obstacle struck under the fender.

The movable scoop fender tested did its work better than the fixed fenders because it was an inch and a half nearer the rail; but it generally pushed the bag ahead of it, and only once did it pick up the bag and carry it along. Moreover, it caused considerable trouble by striking the projecting angle of the rail at switches. More serious objections to the movable fenders were developed, however, in the latter experiments, with the automatic type of movable fenders. These fenders were attached to the truck and were normally held several inches above the rails by a latch. Two or three feet in front of this fender a plank was swung from the car body and was so connected to the latch that when an obstruction was hit by the plank it would swing backwards and tip the latch which held up the fender.

In practice, however, it was found that at ordinary speeds the time occupied by the fender in falling might be sufficient for the car to advance over the space between the tripper and the fender, and the fender would ride up over the body. This objection is only partially obviated if the fender is pushed down by a strong spring when released, instead of falling freely. It was also found that a body of considerable size might pass under the tripper without swinging it enough to drop the fender. In such a fender, therefore, the tripper plank should be placed as near the rail as possible.

Besides these experiments the Board sent circulars of inquiry to some of the principal electric and cable street railway companies, asking information as to the nature of the fenders used. The replies to these inquiries were as a rule not by any means complimentary to the fenders in use, and few were sanguine enough to have faith that any really efficient form of fender could be devised. In fact, one manager wrote as follows:

> In relation to utility of fenders in saving life, my opinion is that they are useless—a delusion and a snare. They look well, the public seems to feel a certain confidence in them, and in this way they remove in the public mind a small amount of objection to electric and other railroads which are propelled without horses and at a higher rate of speed than horse cars; but, for practical benefit, I consider them worse than useless. If cars could be run without fenders, the public would have more fear of them, and would be led to exercise greater caution therefore the best plan is to have no fenders at all.

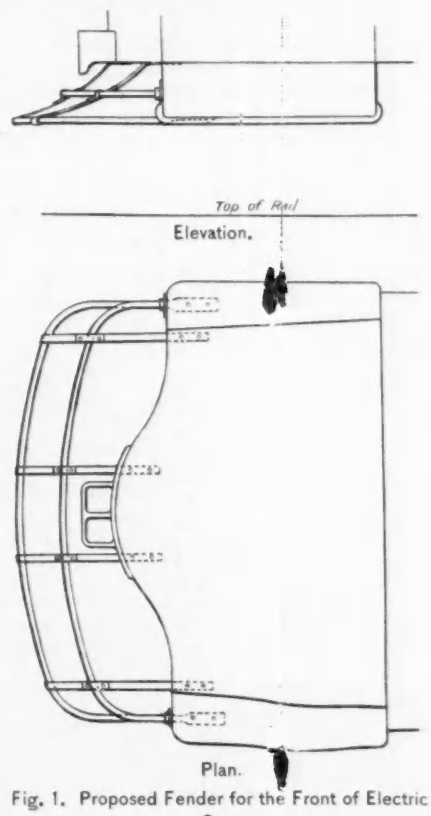


Fig. 1. Proposed Fender for the Front of Electric Cars.

Several cases are, however, cited by several of those who answered the inquiries in which fenders have saved life; and such good authorities as President C. B. HOLMES, of the Chicago City Ry. Co., and THOS. L. JOHNSON, of the Brooklyn Street R. R. Co., of Cleveland, O., report the use of fenders of considerable efficiency. Mr. JOHNSON'S fender is described and commented on as follows:

> It consists of a horizontal shelf, 6 ins. above the rails, extending 2½ ft. in front of the platform. It is composed of an iron rim, to which are attached bars or slats of iron, or, if preferred, a wire netting. Its width is equal to the width of the car, and it is attached by simply slipping the bars which which form the rim through iron hangers attached to the steps. It can therefore be easily taken off. When tow cars are used, a guard may be attached to the rear of the motor car, covering the space between it and the tow car, thus rendering it impossible for a person to fall to the ground between the cars. This fender, however, can simply afford something to hold on to, or to catch a person who is struck while standing up; and it would do no other good in protecting a person who had fallen upon the ground, since it is too far above the rails. In another somewhat similar form of fender, which is not yet in use, a metal frame carrying a rope netting projects several feet in front of the car, and is designed to catch any person who may be standing on the track when struck.

In the light of all the experiments and information collected, Prof. SWAIN recommends that the life guard for electric cars shall consist of two parts.

First, a frame in front of the platform, 15 to 18 ins. above the rails and projecting as far as practicable, which when a person is struck by an electric car, would give him something to catch hold of and perhaps rest on. A proposed form is shown in Fig. 1.

Second, a fixed fender attached to the truck, V-shaped, but with a square nose 15 to 18 ins. across. It should be solidly fixed to the truck frame, should not be over 2½ ins. from the top of the rail, and should project as far in front of the truck as is consistent with rigidity. Attached to the lower edge there should be a continuous thick strip of rubber, rubber hose or other elastic material, stiff enough to aid in pushing a human body, but flexible enough to yield on striking a paving stone. To prevent a body from being rolled under the fender, the front should curve or slope backward.

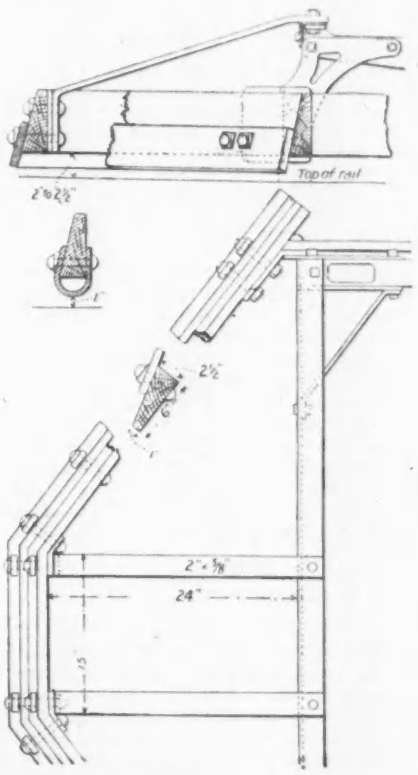


Fig. 2. Proposed Fender for Attachment to Truck Frame.

Fig. 2 shows in a general way the arrangements which seem to afford a good degree of safety. Instead of having the body of this fender consist of a vertical plank, it might be made in the form of a horizontal shelf. (A fender of this type was illustrated in ENGINEERING NEWS of July 26, 1890.) Should a human being be pushed by this fender, there might be some possibility of his getting onto the shelf, while it might be arranged to push him as effectivly as the form shown in Fig. 2.

Prof. SWAIN, in his report, seems to have considered himself limited to the discussion of fenders adapted to the rocking 4-wheel cars in common use; and only at the outset does he refer to the fact that the tilting motion of these cars is the real obstacle to the design of an efficient fender. The Board speak in plainer terms, and show that double truck cars and a properly kept roadway are essential to the satisfactory solution of the problem.

The need of an efficient fender is well shown by the results of brake tests which have been made on electric cars. These results are given as follows:

Speed, miles per hour.	Minimum stop (ft.).	Maximum stop (ft.).	Average stop (ft.).	
7 to 10	23	71	[7 stops]	49
10 to 12	42.5	85	[5 stops]	61
12 to 15	56	95	[7 stops]	79
15 to 21	61.5	157	[5 stops]	113

The *accidents* on the West End Street Railway for the year ending June 30, 1890, have been as follows:

	To passengers getting on or off cars.	To persons on the street.	By collisions with vehicles.	Total. Horse cars.	Total. Electric cars.
Horse cars.....	74	36	21	131	.....
Electric cars.....	28	7	26	.....	61
Fatally injured	2	11	1	9	5
Not fatally injur'd	100	32	46	122	56
Total.....	102	43	47	131	61
				192	

The mileage of horse cars was 14,353,617, and there was one accident to each 109,569 miles run. The mileage of electric cars was 3,311,743 and there was one accident for each 54,291 miles run.

With double the accidents with electric cars that occur with horse cars, the Board well declare that an efficient fender on electric cars is a public necessity, and continue:

While the Board can prescribe a fender which shall be better than nothing, even on an oscillating car and on an uneven road bed, still, none has yet been suggested which has seemed to the Board to give reasonable assurance of safety under existing conditions. * * * * *

The legislature, therefore, imposed upon the Board a task which it cannot accomplish. If the Board could prescribe the kind of cars to be used and the nature of the roadway between the rails, then they could prescribe an efficient fender. The city or town authorities control the roadway. The railway companies determine for themselves what kind of cars they will use.

The Board therefore consider that the responsibility of procuring or devising an efficient fender should rest with the street railway companies. If they desire to run at speeds of 12 to 20 miles per hour, let them use double truck cars, which can run at such speeds without pitching like a ship in a storm, and which can be provided with efficient fenders. If the electric motor is to be applied to 4-wheel cars, let their speed be limited to six or seven miles per hour by the town or city authorities having the matter under control. Such action on the part of the city and town authorities is earnestly urged by the Board.

A New Lead Pipe Joint.

A new lead pipe joint, invented by Messrs. Smith & Cooper, of Middleton, Lancashire, England, is described by *Industries*. The joint is to be used as a substitute for the soldered connection, and it is claimed that it can be made in one-fourth of the time and is considerably cheaper. A right and a left hand thread are formed on the ends of the two pipes, and they are then joined by a coupling nut.

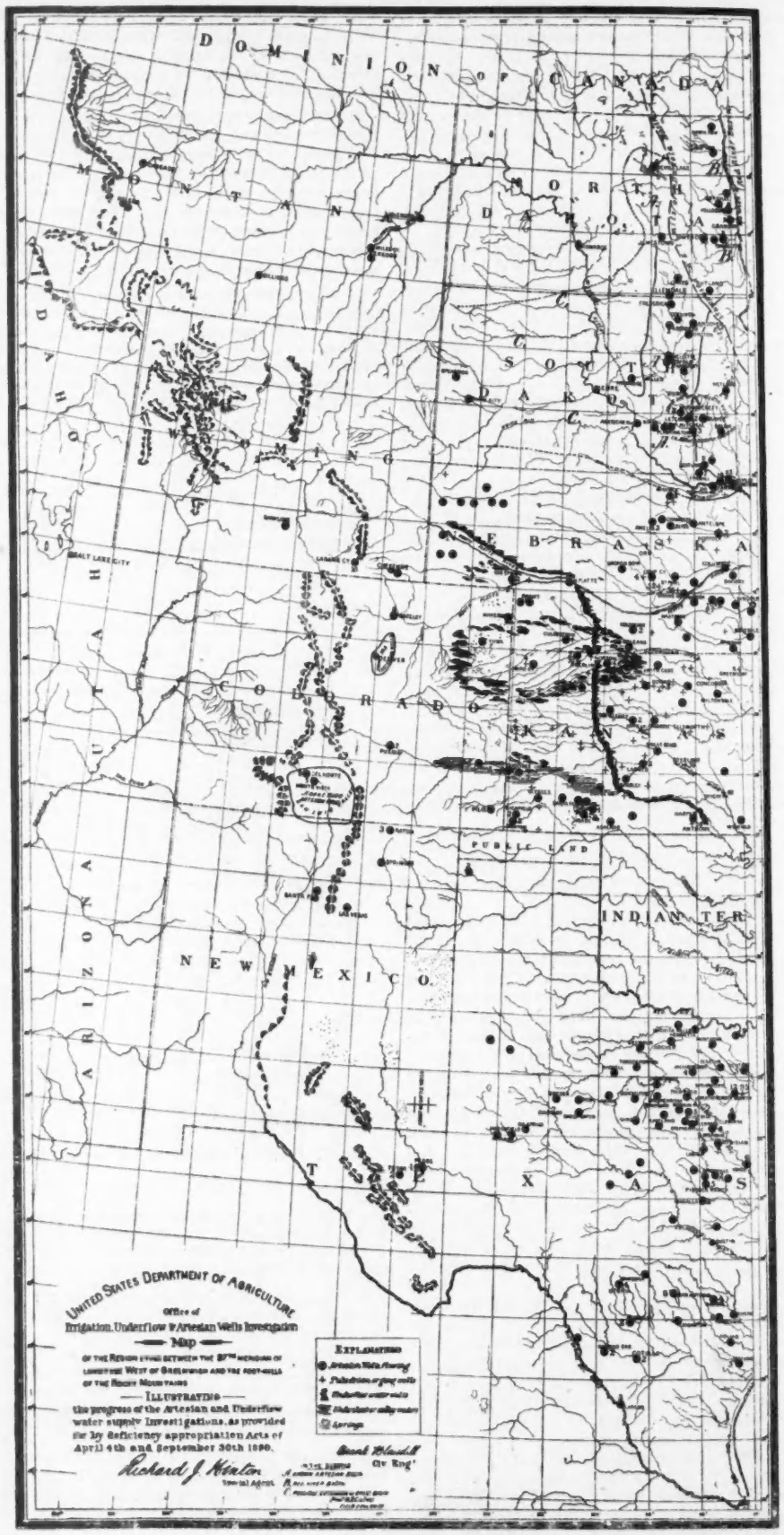
To make these threads the pipe end is first reduced by using a small diminishing tool with an internal conical recess. On the taper thus made an internally threaded nut is placed and a plug is then driven into the pipe, forcing out the lead and transferring to it the thread. This process is repeated with a left-hand thread on the other pipe, and the two ends are then coupled with the nut. The whole outfit can easily be carried in the workman's pocket.

Artesian Well Practice in the Western United States.

I.

NUMBER AND DISTRIBUTION OF WELLS.

In our last issue we outlined the contents of a late government report upon artesian wells in the United States and their relation to irrigation. The investigations reported upon were limited to the area between the ninety-seventh meridian and the eastern foot-hills of the Rocky Mountains, but the report contains some information regarding wells in other sections of our Western States. The report is filled with very valuable matter, necessarily put together in a hasty way for immediate use. We have concluded to digest it further than it was possible for the compilers to do before publication, and to present the most salient features in a series of articles on Artesian Well Practice, to be followed with a consideration of the relation of artesian wells to irrigation.



MAP SHOWING ARTESIAN AND UNDERFLOW WATER SUPPLY IN THE UNITED STATES BETWEEN THE 97TH AND 112TH MERIDIANS.

Reproduced from map accompanying Government Report.

Since the report was issued the U. S. Department of Agriculture has issued a map showing by symbols the location of artesian, tube, driven or gang wells, springs and underflow waters. We reproduce the map herewith. It explains itself, and will be useful in connection with the following data.

As stated last week, the investigations were carried on by several efficient men, each of whom we then named, and will refer to again in the proper connection. It should be stated here, however, that Mr. R. J. HINTON was Special Agent in Charge, Mr. E. S. NETTLETON, Supervising Field Engineer, and Prof. ROBERT HAY, General Field Geologist.

The total area included between the 97th meridian and the eastern foot-hills of the Rocky

Mountains is given by Mr. Hinton as 658,767 miles. This area he subdivides as follows, the figures indicating square miles:

North and South Dakota	147,700	
Wyoming, east of 105°	27,462	
		175,162
Nebraska, west of 97°	65,845	
Kansas, " "	54,175	
Public land strip	5,740	
Indian Territory, west of 97°	69,830	
1° of eastern Colorado	19,250	
		214,740
Colorado, east of 105°, (less above strip)	57,062	
New Mexico, " "	48,303	
Texas, between 97° and 105°, and as far south as latitude 38°	163,500	
		268,865
		658,767

This territory was traversed as extensively as time permitted, and the conditions demanded. Messrs. HAY and NETTLETON traveled 12,000 miles each, while the total mileage covered was about 110,000.

The aim of the investigation being to determine "the proper location of artesian wells" within the territory named, it was necessary to ascertain the number, characteristics and location of present wells and the geological formation of the country. In the instructions issued artesian waters were defined as follows:

To include all subterranean waters which, on being reached or opened from above, are found to flow by pressure to a level higher than the point of contact. Another consideration is, that the said waters shall flow from some permanent and general source rather than from a local and temporary one. All bored wells in which the water rises, though not above the surface, may be included in the term artesian; also all natural waters, such as springs rising from below, are embraced in this definition.

In the geological investigations Professor HAY made use of the following questions:

1. In the region under examination are there any artesian wells now used for irrigation?
2. If so, are the wells so used in groups or isolated?
3. Are any of the wells available for irrigation to a larger extent than at present?
4. Can the areas in which existing wells are found be defined and their geologic conditions determined?
5. Are there other areas whose conditions are similar where artesian water may probably or possibly be found?
6. May the areas already known be expected to yield more water with further exploration?
7. In what way are the phenomena of springs and the subflow of river valleys related to the conditions of artesian wells, and are the springs and subflows available for irrigation?

It was found that there are many groups of wells whose waters may be used for irrigation, and some are already so used. The latter can be developed still further. The wells, without regard to their use, lie in the following geographical groups:

1. The wells of the Red River Valley in northeastern North Dakota.
2. The wells of the James River Valley in the two Dakotas (North and South).
3. The wells of the Yellowstone Valley at Miles City, Mont.
4. The shallow wells in the drift formation on the eastern side of the two Dakotas.
5. The wells of northern Nebraska.
6. Four groups of wells in southwestern Kansas.
7. The wells of the La Poudre, Denver, and Pueblo basins in Colorado.
8. The Fort Worth and Waco groups in Texas.
9. The wells of New Mexico.
10. The wells of Wyoming.

Aside from the New Mexico group these wells, broadly speaking, are flowing, and recent developments promise numerous flowing wells in New Mexico, while at least one such is already in existence.

As might be expected, the wells in the various groups derive their flow from formations of very different geologic ages. From the latest to the oldest these are: The glacial drift, tertiary formations, Laramie, Dakota sandstone and triassic "red beds." The shallow wells in the eastern part of the two Dakotas are supplied from the glacial drift. In the Denver basin, and in and for some distance east of the city, the wells seem, generally, to draw water from the Arapahoe, a tertiary formation. There is one well in Denver, that at the court-house, which extends to the Laramie, a cretaceous formation. The whole of the James River group draws from the Dakota sandstone. It is thought that this formation extends south into northern Nebraska and gives rise to artesian conditions there. It is stated that on the western sides of the Black Hills, in Wyoming, the Dakota sandstones yield flowing wells of salt water, with oil and natural gas present. In southwestern Kansas and just over the line in Colorado a group of wells less than 300 ft. deep are also supplied from the Dakota sandstones. This stone also crops out in middle Kansas and eastern Nebraska, giving evidence of artesian conditions, but it is thought their supply comes from local breaks rather than from the outcrops in the Rocky Mountains, as is the case in the James River group. In another part of southwestern Kansas, northeast from Meade Center, in the upper valley of Crooked Creek, a group of wells derives its supply from tertiary grit. At Larned, Great Bend and in Morton Co., near the Colorado line, the wells tap water in the triassic "red beds."

The exact number of artesian wells in the area investigated cannot be given. Prof. HAY states that there are 1,400 wells, all of which were originally flowing, but 300 to 400 of which now require pumping to make their waters available. But Mr. NETTLETON makes the number nearly double the above, giving it in detail by sections as follows: 150 high-pressure wells in the Dakota basin, including, with those in the Dakotas, the few in the Yellowstone Valley of Montana; *several hundred* flowing wells in South Dakota, evidently not connected with the great Dakota basin; over a thousand small flowing wells in the Red River group; in northern Wyoming 60 flowing wells; in the central section of the great plains, from the northern boundary of Nebraska to the southern boundary of Indian Territory, about 200 flowing wells, with several hundred more in which the water rises but does not reach the surface; in Colorado, at least 250 flowing wells in the Denver group and 100 non-flowing, together with 12 wells at Greeley and 8 at Pueblo; at Florence and Cañon City, Colo., several heavy flows have been struck in boring for oil; in Texas nearly 700 flowing wells are referred to by Field Agent ROESLER. We have here, enumerated by Mr. HINTON, in his review of the reports of the various agents, a total of 2,360 flowing wells, with "several hundred" additional flowing wells in South Dakota, 100 non-flowing wells in the Denver basin, and other non-flowing wells not enumerated. These figures would indicate that there are in the area investigated at least 2,500 flowing wells. The number of non-flowing wells cannot well be estimated.

Outside of the area under consideration, in notes and incidental references, wells are mentioned as follows:

Over 2,000 flowing wells in the San Luis Valley, west of central South Colorado, all sunk within the past three years, and mostly in the year 1889-90; about 2,000 flowing wells, of small bore, in Utah, in the Salt and Utah lake's region, with water rising from 2 to 5 ins. above the top of the casings; 67 flowing wells in Nevada; 2,000 flowing wells in the San Bernardino basin, Cal.; 200 flowing wells at a high altitude, in Sierra Co., Cal.; 100 flowing wells near Tulare Lake, Cal.; 40 large flowing wells in Kern Co., Cal., just south of Tulare Lake, within a radius of 10 miles, and with an average daily flow of about 600,000 galls. The number of wells just named is about 6,400, which, with those in the area to which the investigations were confined, makes a total of nearly 9,000 flowing artesian wells in the western United States. Some of the figures given are probably estimates, but, on the other hand, it is likely that some groups are omitted. Were figures available for non-flowing artesian wells, we would have a much more surprising total, but one which it seems useless to estimate.

Further comments and more detailed information regarding the wells of the several sections investigated are reserved for further issues.

To Detect Weak Points in a Machine in a Noisy Workshop.

A French engineer, Mr. ROBERT BOUCOURT, recommends the following plan for detecting weak spots or faulty action in a machine in a noisy workshop: For the purpose of isolating sounds in the machine under investigation, he uses a piece of ordinary rubber gas hose, about 3 ft. long, with one end introduced into the ear and the other end applied to the part of the machine being studied. Mr. BOUCOURT claims, in *Le Genie Civil*, that he can thus locate friction or other trouble in the several bearings regardless of the noise about him.

The Elmore Process of Copper Depositing.

Since the publication last week of the letter describing the Leeds works of this company, we have received another and somewhat less roseate account of the company's affairs from another English correspondent, who states that the shares of a company to control the American patents on the process are soon to be floated, and that this was the reason why the Leeds works were opened to inspection recently. His description of the Leeds works is substantially the same as that given last week. Our correspondent criticises the financial methods of the owners of the Elmore process, and gives the following table, showing the capitalization of the various companies, and the amount which each of them has paid for the Elmore patents, which it controls:

COMPANY.	Capital issued.	Amount paid for patents.	
		Cash.	Shares.
Elmore Co. (British)	$700,000	$267,000	$233,000
Elmore's Wire Co.	1,000,100	375,000	100
Premium	500,000	250,000	
Elmore's Foreign & Colonial Co	600,000	400,000	150,000
Elmore's French Co.	1,000,000	417,500	312,500
Premium	166,875	166,875	
Elmore's Austro-Hungarian Co	1,000,000	250,000	250,000
Premium	187,500	187,500	
	$5,154,475	$2,313,875	$965,600
		$3,279,475	

It should be said that the wire company purchased its rights of the British company, and the two last in the table bought theirs of the Foreign & Colonial Co. These two parent companies, therefore, have made a handsome profit on their investment already.

Our correspondent comments that, out of the total capital issued, more than half has been paid out for patent rights; and that the sellers of the patents show a decided partiality for cash instead of taking the shares in the company which is to work the process. Of course, it is not questioned that the process is practicable, and that its product is of remarkably fine quality. Some doubt still seems to exist, however, as to the actual cost of working the process. The standing of the company is doubtless very much injured by the secretive policy of its managers, and also—as often happens in similar cases—by their very extravagant claims concerning the value of the process. From other sources we hear that claims are made that the process is to be extended to other metals, as, for instance, iron; and that the projectors have an idea that boiler shells can be made in this way without seams. Unless chemically pure iron is a different substance from what it is now supposed to be, it is safe to say that boilers will not be made from electro-deposited iron for some time to come.

Cement vs. Wet and Dry Sand.

The liability to error in mixing cement with wet and dry sand is described by M. CANDLOT, and an abstract of his paper given in the *Journal* of the Society of Chemical Industry. FERET has pointed out the possibility of serious mistakes in the proportions of mixtures of cement and sand due to a disregard of the condition of the sand—whether wet or dry. This is demonstrated by the following table:

Quantity of water added to 100 kilos. of dry sand	Kilos.						
	..	0.5	1	2	3	5	10
Weight of a cubic metre of moist sand	1458	1310	1238	1213	1209	1208	1208
Weight of dry sand contained in 1 cubic metre of moist sand	1458	1304	1226	1189	1174	1151	1149

It is obvious that the addition of comparatively little water largely increases the bulk of the sand—out of all proportion to the amount used. For instance, 2 per cent. causes the weight of a cubic metre of the moistened sand to decrease 269 kilos.; that is to say, 18.5 per cent. of the original weight. Such difference would cause great fluctuations, hitherto generally overlooked, in the composition of mortar mixtures intended to be of a certain strength —*The Engineer*.

Notes on English Railways.

(*Continued from p. 137.*)

GREAT WESTERN RAILWAY.

This is one of the most important trunk lines and has the greatest mileage of all English railways. Its system, which is much ramified, comprises a total of 2,481 miles. Its principal main line is from London to Reading, Swindon (where are located the company's locomotive and car works), Bath, Bristol, Taunton, Exeter, Plymouth (247 miles), and Penzance, the last named place being almost at the extreme southwest point of the island. This part of the line has the old broad gage of 7 ft. throughout, and as far as Exeter (194 miles from London) it has the mixed gage of 7 ft. and 4 ft. 8½ ins. All the rest of the system is now laid to the standard gage of 4 ft. 8½ ins. The system also includes a main line, by Swindon and Gloucester (or by Bristol and the Severn tunnel), through South Wales to Newport, Cardiff and Swansea, and terminating at Milford Haven, 285½ miles from London. A third main line runs by Oxford, Birmingham and Manchester to Birkenhead, on the bank of the Mersey, opposite Liverpool, a distance of 229 miles from London. These are the three main routes of a comprehensive system, which is a very network of branches and connecting lines. The original Great Western line was from London to Bristol, 118 miles. Mr. BRUNEL was the engineer, and adopted the 7 ft. gage on this and some other lines for the same company. Mr. STEPHENSON, however, had adopted the gage of 4 ft. 8½ ins., which has since become the standard, and when the increasing construction of railways led to their forming connecting lines, there ensued what is known in railway history as "the battle of the gages," which resulted eventually in a victory for the narrower or standard gage. It may be noted, however, that this is not the standard gage of the British possessions; the Irish gage is 5 ft. 3 ins., the Indian gage is 5 ft. 6 ins. (with a secondary system of 1 meter gage), and in the Australasian colonies there are gages of 3 ft. 6 ins., 4 ft. 8½ ins. and 5 ft. 3 ins.

Track.—For the original line Mr. BRUNEL designed a special form of track which is still in use for probably about 400 miles, including the broad and mixed gage line from London to Penzance, some branch lines in the west of England, and on the South Wales line as far as Gloucester. It consists of rails of bridge section, bolted to longitudinal timbers, which are connected at intervals of about 11 or 12 ft. by wooden transoms. The rails are 6¼ ins. wide over the flanges, 3 ins. high, and 2.3 ins. wide in the head; they weigh 68 lbs. yer yd. The longitudinal timbers are of creosoted pine, 15 ins. wide, 7 and 7½ ins. deep on the inner and outer sides respectively. The third rail is on the inner side of each track, the outer rail being common to both gages. Fig. 3 shows a cross section of the double track with mixed gage, with two methods of notching the transoms into the longitudinals. It also shows two methods of tying the timbers together. On the left-hand track are shown rods having about half their length flattened, and secured to the transoms by bolts or spikes, while nuts and washers are screwed up on the outer side of the longitudinals. On the right-hand track is shown a through tie rod. The short transoms are not placed in line with the long ones. All the rails are laid to break joint. The rail ends rest on an iron plate which has a rib on the upper side fitting into the hollow of the rails. No ordinary joint bolts are used. The rails do not rest directly upon the longitudinals, but upon a continuous bearing of wooden plates, or shims, about 7 ins. square and 1 in. thick, which are placed with the grain transverse to the rail so as to reduce the flange cutting. These plates are not creosoted. The rails are secured by bolts which pass through the rail flange and the timbers; the head of the bolt bears on the rail flange, and on the underside of the longitudinal is a nut and a fang washer which bites into the wood and prevents the nut from turning, so that the bolt can be screwed down through it. There are generally two or four bolts at the end of each rail, and seven intermediate bolts, staggered on each side of the head. The ballast is of broken stone, generally with a boxing or top layer of coarse gravel, nearly level with the tops of the timbers. In some places the ballast is level across the track. In other places there is a longitudinal drain between the standard gage timbers, which extends a few inches below the bottom of the transoms, as shown in Fig. 3. The line has four tracks for some distance from London, and the earthwork, bridges, etc., for extending the two additional tracks are in progress at different points. Messrs. Lucas & Aird are the contractors. The two older tracks are of the form above described, but the two newer ones are of standard gage, laid with bull-headed rails in cast-iron chairs on cross ties. Near the Paddington terminus, London, is a double track of mixed gage, laid with the bull-headed rails on cross ties. There are several miles of three-track line. A considerable amount of work for new yards, side tracks, widenings, etc., is in progress at various points. This bridge rail style of track, with its continuous bearings, makes a smooth and even riding track, free from noise and from the pounding of rail joints. The track is kept clean and in excellent condition, and has a very attractive appearance.

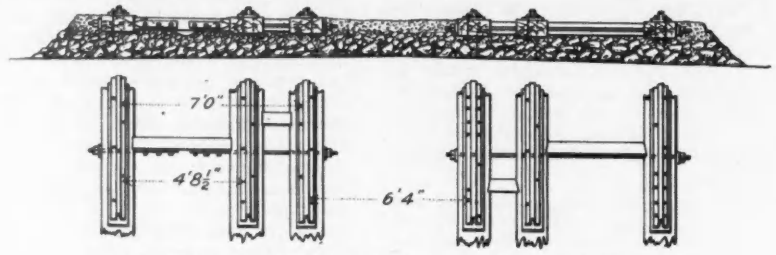


FIG. 3. CROSS SECTION AND PLAN OF DOUBLE TRACK, MIXED GAGE.

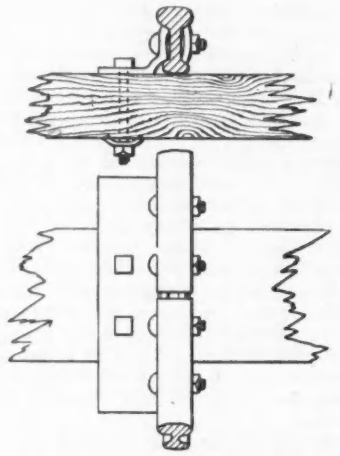


FIG. 4. CROSS SECTION & PLAN OF SUPPORTED JOINT.

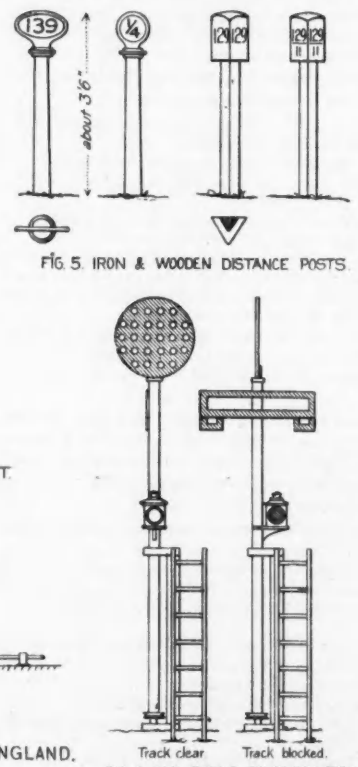


FIG. 5. IRON & WOODEN DISTANCE POSTS.

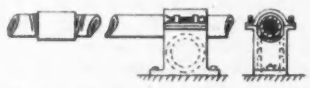


FIG. 7. SWITCH ROD CARRIER & COUPLING.

FIG. 8. SWITCH ROD COMPENSATING LEVERS.

TRACK DETAILS; GREAT WESTERN RY., ENGLAND.

FIG. 6. OLD STYLE OF BLOCK SIGNAL.

The following table shows the number of feet of timber, board measure, per mile of single track in the standard, broad and mixed gage tracks of the Great Western Ry., a broad gage track on cross ties and the American style of track:

Track.	*Size of ties.*	*Ft. B. M.*
S. gage; 2,112 ties per mile..	9 ft. × 10 × 5 ins.	950,000
B. or M. gage; 2,112 ties per mile.....	11 ft. × 10 × 5 ins.	1,161,600
S. gage; 2,640 ties per mile..	8½ ft. × 8 × 6 ins.	1,077,120
B. " longitudinals.....	15 × 7 × 7⅛ ins.	1,695,940
M. " transoms.	6 ft. × 6 × 6 ins.	2,382,870

The South Wales line, which leaves the old main line at Swindon, is a double track line of standard gage, and as far as Gloucester it is laid with bridge rails on longitudinal timbers. The bridge rails are of Landore Siemens steel, and are laid on wooden packing blocks or shims, and secured by fang bolts, as already described. At one place flange rails are substituted, secured to the longitudinals by fang bolts and spliced by straight splice bars with four bolts. The iron straps are secured to the transoms by bolts and spikes; each strap has one spike and a bolt at the end, the nut screwing up against the strap and the head being on the other side of the transom. In some cases both straps are on the same side, and in others they are on opposite sides of the transom. Beyond Gloucester the line is laid with bull-headed rails carried in cast-iron chairs which are secured to cross ties by two fang bolts to each chair. The inner face of the jaw of the chair is slightly concave to the rail, so that the wooden key may swell and be prevented from working loose. A nail is also driven into the key at each side of the jaw of the chair. The rails are laid with square suspended joints, spliced with plain splice bars and four bolts, with hexagonal pan heads on the outer side of the rail. The wooden keys are generally driven on the outer side of the rails, but in some cases on the inner side. West of the junction with the Severn tunnel line there are some stretches of track laid with square supported joints of the form shown in Fig. 4. There are 12 ties to a rail, and the rail ends rest on a tie of extra width. On the outer side of the rail is an angle bar secured to the tie by two bolts through the flange, and on the inner side is a plain splice bar. There are four joint bolts, with their heads on the inner side of the rail. This track is not so smooth to ride over as that with suspended joints. The ballast is of broken stone, level with the tops of the ties, and sometimes covers the ends of the ties, but is kept clear of the splice bars. In some places there is a longitudinal drain in the ballast between the rails, as already noted. The Portishead branch, a short, single track, standard gage line near Bristol, is laid with bull-headed rails made at the Blaenavon works. They are 30 ft. long, 5⅝ ins. deep, with heads 2½ ins. wide and about 1½ ins. deep. The cast-iron chairs are 15 ins. long, 4 ins. wide on the inner side,

and 8¼ ins. wide on the outer side of the rail; they are secured by a fang bolt on each side. The keys are on the outer side of the rail and are prevented from slacking back by a nail driven vertically into each against the jaw of the chair. The rails are laid with square suspended joints, spliced by 18-in. splice bars; the inner bars are straight, but the outer ones are angle bars similar to those above described as used with supported joints. The flange is 4¼ ins. wide and has two bolt holes. The joint bolts are spaced 4½ ins. c. to c. They have large round heads on the inner side of the rail, and washers and square nuts on the outer side. There are 12 ties to a rail length spaced about 2 ft. 3 ins. c. to c. at the joints. The ballast is of coarse broken stone, level with the tops of the ties, and is in some places retained by a rough, dry wall of large stones on each side. There are also on this branch some flange or T-rails, secured by 2 fang bolts to each tie. They have 9 ties to a rail length, and are laid with even suspended joints, spliced by straight splice bars and 4 bolts. The track in the Severn tunnel is laid with bridge rails on longitudinals, but the approaches are laid with bull-headed rails on cross ties, with the splice bars butting against the chairs. On the up line of each approach are several "catch-points" or derailing switches, set to turn runaway cars or trains into the bank. The extensive yards at Swindon are laid with the old-fashioned Barlow "saddle" rails, which were designed to obviate the use of cross ties; they are secured at the joints to flat cross ties by bolts, and are packed in ash ballast. These Barlow rails are to be seen in side tracks at various points along the line. In some places side tracks are laid with flange rails, or with bridge rails on longitudinal iron plates. Flange rails are used for the third rail of mixed-gage track at point between Nailsea and Yatton, west of Bristol, on the main line; they are spliced by plain splice bars and 4 bolts. Frogs and switches on the mixed gage are somewhat complicated. The company's present standard type of track consists of bull-headed steel rails weighing 86 lbs. per yd., carried in cast-iron chairs weighing 46 lbs. each, which are secured to the cross ties by two ⅝-in. fang bolts to each chair. The rails are laid with square suspended joints, spliced by deep splice bars, the lower parts of which embrace the lower head of the rail. The splice bars are 20 ins. long, and have kite-shaped bolt holes.

On bridges, longitudinal timbers are very generally used to carry the track. On some short bridges, having floors of transverse iron troughs, old rails are laid across the troughs for the ties to rest on. A sharp turnout curve from the main line, just west of Bristol station, has the ends of the bridge rails mortised together, on account of the sharp curve. Along the main line between London and Bristol there are neatly stacked at intervals some short pieces of bridge and Barlow rails. The long, wooden track lever, with iron-shod end, is used in track maintenance.

Trains keep to the left, as on all English railways. The mile posts are to the right and the signal posts to the left of the trains going from London. A distance post is placed every quarter of a mile. They are generally of wood, of triangular section, with an enlarged head of the same form, as shown in Fig. 5. The intermediate posts have the mile painted on the upper part of the head, with one, two or three strokes below for the ¼, ½ or ¾-mile, as shown in the cut. Cast-iron posts surmounted by discs, with raised figures, are also used, and are shown in Fig. 5. They are, however, liable to be broken, many of them having the disc knocked off, and they are not so easily distinguished as the wooden posts. Both iron and wooden posts are painted white, with block figures in black. Semaphore signals of the ordinary type are used. Swallow-tail blades indicate the signals for main line fast trains, and at stations, yards, etc., there is painted in white block letters on the red face of the blades of side track signals the name or mark of the track to which they belong. Some of the old-fashioned signals still in use are shown in Fig. 6. The post turns on a footstep bearing and carries a red disc and cross arm, the former signifying "track clear," and the latter "track blocked." The cross arms of the down track signals are distinguished by the downward projection at each end. The lamps of these old signals are generally placed low down, and turn with the post, displaying a red or a white light. On some signal posts the lamps are hoisted by a winch and chain attached to the post. Semaphore signals out of use for repairs, etc., have a wooden cross nailed at the top. The Portishead branch, above referred to, has some old signals in which the disc is intersected by the cross arm and revolves on a horizontal axis. The telegraph poles are supported by wire stays, connected by turnbuckles with the anchor rods and plates buried in the earth. The plates are about 10 × 24 ins., and have a hub about 8 ins. deep in the middle of the under side, with 8 radiating ribs or feathers. The rod passes through the plate, and is secured by a nut on the hub. The plates, rods, turnbuckles, and stays are all galvanized. The switch rods are of gas pipe with screw couplings.

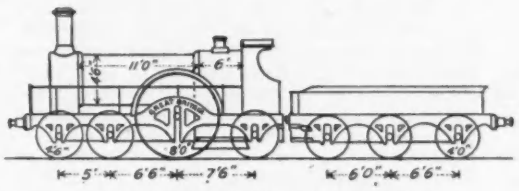


FIG. 9. BROAD GAGE EXPRESS ENGINE.

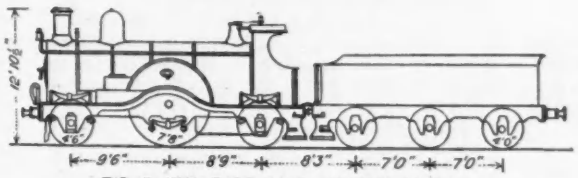


FIG. 10. STANDARD GAGE EXPRESS ENGINE.

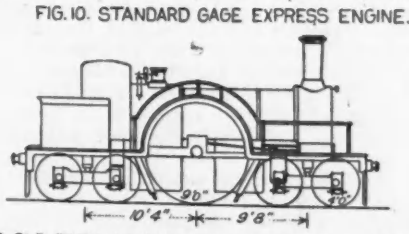


FIG. 11. OLD TYPE OF EXPRESS TANK ENGINE, BROAD GAGE.

LOCOMOTIVES: GREAT WESTERN RY., ENGLAND.

The form of carrier for switch rods is shown in Fig. 7, and the usual style of compensating lever for switch rods in Fig. 8. The signals are operated by galvanized wires. To prevent cars from being accidentally or maliciously moved out from a side track to foul the main track, a sliding "scotch block" or wheel stop is sometimes used, operated in connection with the switch. As the switch is closed an iron-faced wooden block, moving in angle iron guides, is pushed across one of the rails of the side track. The stop is placed sufficiently far back on the side track that passing trains will clear a car standing with its front wheel against the stop. Bumper blocks or buffer stop frames made of old rails bent to shape are very generally used. There are several road crossings at grade, but each is provided with strong gates, which are attended to by a watchman living in a house built close to the track.

As on all English railways, the slopes of cuts and fills are sodded and kept well trimmed. Patches of gorse are seen in places, and small plantations of firs occasionally on the bank. In July haymaking was in progress on the slopes all along the line. Later in the season the thick, close hedge fences are clipped, the clippings left for a while to dry, and then gathered into heaps and burned. The trackmen form a splendid corps. They are as a rule big, powerful men, honest and intelligent looking, and well dressed in heavy white corduroy trousers and sleeved vests, the latter being generally removed during work. White shirts, straw or felt hats or caps, and heavy laced shoes complete the costume, and a majority of the men seem to be provided with large silver watches of old fashioned appearance.

Locomotives.—The most noted engines of this road are the broad gage express engines which were designed in 1846 by Mr. (afterward Sir) DANIEL GOOCH, the inventor of the Gooch stationary link valve gear. Engines of this class are still in use, and an outline diagram of one is shown in Fig. 9. One of these engines, the "Lord of the Isles," was built in 1850 and sent to the great exhibition of 1851; in 1852 it was put in service and continued till 1881, making a total of 789,300 miles. This engine was in the railway court of the Edinburgh Exhibition last year. The leading dimensions are as follows: Cylinders, 18 × 24 ins.; driving wheels, 8 ft. diameter; leading and trailing wheels (the former are not carried in a truck frame), 4 ft. 6 ins. diameter. The boiler barrel is 10 ft. 9 ins. long, 4 ft. 9 ins. diameter, and there are 300 tubes 2 ins. outside diameter and 11 ft. 1 in. long. Copper firebox, 5 ft. 6 ins. long and 6 ft. wide. Heating surface: tubes, 1,611 sq. ft.; firebox, 156 sq. ft.; total, 1,767 sq. ft. Grate area, 25.46 sq. ft. The valve gear is of the Gooch fixed link type. An engine of this class built in 1880 had the following dimensions, the cylinders and wheels being the same; Boiler, 4 ft. 6 ins. diameter, with 332 tubes 1⅝ ins. diameter and 11 ft. 5¼ ins. long. Firebox, 5 ft. ×6 ft. Heating surface: tubes, 1,598 sq. ft.; firebox, 153 sq. ft.; total, 1,751 sq. ft. Grate area, 24 sq. ft. There is no dome, and the older engines had no cab, the only protection being a vertical "weather board" across the end of the boiler, with a round glass window in each side. The later engines, however, have the modern English style of cab. These engines are said to have been capable of evaporating 300 cu. ft. of water per hour, with a coal consumption of 2½ lbs. per HP. per hour. The weight is as follows: On four leading wheels, 35,616 lbs.; on driving wheels, 35,840 lbs.; on trailing wheels, 21,952 lbs.; total, 93,408 lbs. The tender is carried on six wheels 4 ft. diameter, and weighs 67,200 lbs.; the tank has a capacity of 3,000 galls. (3,600 U. S. galls.) of water.

Fig. 10 represents a standard gage express passenger engine. Cylinders, 18 × 26 ins.; driving wheels, 7 ft. 8 ins. diameter, leading and trailing wheels, 4 ft. 6 ins. diameter. Boiler, 50 ins. diameter, 10 ft. 8 ins. long; firebox, 6 ft. 2 ins. × 4 ft. Heating surface, 1,291 sq. ft. Weight, 91,840 lbs. An engine of this class, fitted with outside eccentrics, was built about 1885. Passenger engines with four coupled driving wheels are also used. The engines with a single pair of driving wheels somehave a difficulty in starting a heavy train, and they are not fitted with the apparatus for blowing sand under the drivers, which is used on other lines for engines with single and coupled driving wheels. The engines make very little smoke, but when coal is thrown on the fire the steam from the stack looks rather dirty for a short time. Inside cylinders are used exclusively. Experiments were made some time ago with two compound locomotives; they are said to have been of the four-cylinder tandem type. Fig. 11 shows an engine which several years ago made the famous record of 80 miles an hour, on an easy down grade and with a light train. Engines of this class were built in 1853 for the express service of the Bristol & Exeter Ry. (now a part of the Great Western Ry.), but are now obsolete, although some have been modified and fitted with 8-ft. wheels and tenders. They were broad gage, inside cylinder engines, with two four-wheel trucks or "bogies," and their leading dimensions were as follows: Cylinders, 17 × 24 ins.; driving wheels, 9 ft. diameter; truck wheels, 4 ft. diameter. The boiler was 48½ ins. diameter, and there were 180 tubes 1¾ ins. diameter and 11 ft. 2 ins. long. The weight of the engine was 94,080 lbs.

For freight service, engines with 6 wheels, all coupled, are used, and there is a large number of ugly but powerful saddle tank engines with six wheels, all coupled, for freight, switching, etc., and for use on "banks" or heavy grades. For local passenger service side tank engines, with four coupled wheels and a single pair of leading wheels, are much used. Some of them have cylinders 17 × 24 ins. and driving wheels 66 ins. diameter. Many of

the broad-gage tenders have very low sides; those for the standard gage have higher sides, and some of them have rails around the top, as on the engine illustrated on p. 136. The vacuum for the train brake is created by means of an ejector, and is maintained by an air pump worked from the crosshead; when the vacuum gage indicates 25 lbs. a valve shuts off the pump automatically. The air pump gear makes a continuous clicking sound when the engine is running, which, until the cause is ascertained, leads one to think that some part of the running gear must be very slack. Most of the engines are fitted with steam brakes worked as part of the continuous brake system. The express engines have a very handsome appearance. The boiler, cab, wheels, tender, etc., are painted a dark, warm green with black and red or black and orange striping; the frames, steps and wheel splashers are Indian red with black and red striping. The smokebox and smokestack are black, and the latter has a copper moulding on the top; the safety valve casing is of brass and the dome is sometimes of brass and sometimes painted green. On the broad gage engines the upper part of the driving wheels is not boxed in, but the tire is covered by a semi-circular splasher of bright brass; on the standard gage engines the upper part of the driving wheels is generally covered in, the wheel cover being painted brown and bearing the company's arms.

E. E. R. T.

[To be continued.]

The Massachusetts Railroad Commission's Report.

The matter of greatest interest in this year's report of the Massachusetts Railroad Commission is that concerning fenders for electric street cars. We have abstracted this at length elsewhere in this issue.

CASUALTIES TO TRESPASSERS.

The report opens with a broadside against an evil which causes nearly as many deaths as result from all other causes in connection with the operation of railways—the evil of trespassing. During the past year 119 trespassers were killed and 80 were injured in the State of Massachusetts, while the total killed on the railroad by all causes other than trespassing was but 138. Of these trespassers 158 were walking on the tracks and no less than 41 were stealing rides on freight trains. The extent to which the railway tracks about Boston are used as footpaths is astonishing. The Commission estimates (from rather meager data, it is true) that within a radius of 20 miles of Boston there are on pleasant days as many as 40,000 people using the tracks as a footway without right. Moreover, the number of trespassers killed and injured is increasing. In 1879 but 82 accidents of this sort were reported. For four years past the average has been 196. The Commission urges as a remedy more stringent laws against trespassing; but a law which public opinion does not support has small chance of being enforced, and public opinion manifestly will not approve the infliction of fines or imprisonment on a man for merely walking on the railway track. A remedy for the evil, which perhaps deserves a trial, is outlined by the Board as follows:

> The people who find walking on the tracks convenient ought not to ask that such convenience be continued to them at the cost of 120 lives per year. . . . If the public convenience requires a footway along the line of a railroad, such footway should be provided; but it should be a safe footway, and should not be laid out on the roadbed of the railroad. The expense of laying out footways at the side of the location of a railroad would generally be small. The statutes give cities and towns the authority to provide footways for the use of the public in the manner provided for the laying out of town ways, and such ways can therefore be provided wherever the need is sufficient to justify the expense.

This is almost like inviting people to walk on the right of way, however, which is apt to end by walking on the track, with a man as with a cow. A better remedy, which is invariably effective, is to rock-ballast a track which is much trespassed on.

AUTOMATIC FREIGHT CAR COUPLERS.

On this topic there has been much curiosity to see what action the Commission would take, in view of the notably hostile attitude of the New England railway mechanical officers toward the M. C. B. coupler. The Commission long ago took advanced ground on this question. It was largely through its influence that the resolution was adopted in May, 1890, by the convention of State Railroad Commissions favoring both state and national legislation to compel the application of locomotive driver brakes, automatic air brakes, and M. C. B. automatic couplers on all new rolling stock.

At present the Commission speaks in a rather cautious tone. It gives the stock argument of the two or three men who are so severely opposing the M. C. B. coupler that its percentage of breakages is very large, and it assents to the proposition that the M. C. B. coupler is dangerous to couple to the common drawhead as compared with coupling two common drawheads. It is to be regretted that the Commission has not gone into this matter more thoroughly and investigated these claims as to the enormous breakages of the M. C. B. coupler on two or three New England roads, since it sees fit to give credence to them. Statistics have been published covering many thousand miles of railway and many thousand couplers, and showing a remarkably small breakage in service of one make of the M. C. B. coupler. The one or two New England roads which stand alone in claiming an enormous breakage of the best types of M. C. B. coupler have ignored repeated requests for data by which to verify their claims. The only body with power to investigate the actual condition of affairs on these roads is the Massachusetts Railroad Commission. Remembering, however, that much of the power of the Commission for good depends on the maintenance of friendly relations with the railway officers, its delicate handling of the coupler question this year may be excused, especially as it gives its formal approval of all couplers of the M. C. B. type and announces that some of the approvals heretofore issued of automatic couplers not of the M. C. B. type may be revoked.

OTHER REFORMS RELATING TO ROLLING STOCK.

The investigation of the accident at Quincy, in August last, where a train was derailed by a track-jack, was reviewed in our issue of Nov. 22, 1890. This accident has given a needed impetus to improvements in brake practice on the Old Colony, and it ought to stir up the managers of some other roads to look after the brake equipment on their passenger trains. The investigation showed that most of the other roads in the state were more lax than the Old Colony in this matter. Concerning the application of air brakes to freight cars, the Commission speaks in strong terms, and urges that the reform will save dollars as well as lives. Some of the New England roads have already made fair progress in this matter.

In car heating a little progress has been made during the past year; but some of the roads are very loth to part with "the deadly car stove," and the commission regretfully says that another railroad holocaust may be necessary to complete the reform. The number of steam-heated cars on Massachusetts railways was 1,347 in 1890, against 1,163 in 1889. These roads still have 1,216 cars heated by individual heaters.

Another cherished relic of old-time practice which ought to be replaced by something better is the bell rope. As the commission concisely says, "On most of our trains the bell rope is a delusion."

PERMANENT WAY IMPROVEMENTS.

The matter of foot guards for frogs, guard rails and switches was placed under control of the commission in 1886, and railroad corporations were required by the law to complete the work before Jan. 1, 1887, or forfeit from $100 to $1,000 The matter was entirely ignored until after the date set had passed; and the commission reports the present state of affairs to be as follows:

> Between the 1st of January, 1887, and the present time, considerable progress has been made. While the method of blocking or filling adopted by some of the roads has proved to be unsatisfactory, and while other roads which have adopted a satisfactory method have not yet completed the work, still all the companies have, by their general managers, given to the Board assurance that it is their attention with all reasonable expedition to complete the equipment of their lines according to methods approved by the Board.

One wonders after reading the above just what "all reasonable expedition" signifies in Massachusetts.

At the rate grade crossings are increasing in Massachusetts it appears likely at first sight to be a good while before they are all abolished. The present number in the state is 2,234, an increase of 16 over last year. This increase is principally due, however, to a correction of the count on the Boston & Maine. The total number abolished during the year was 21, and 15 new ones were made on the Grafton & Upton R. R. However, the Commission is doing all it can to further the reform. It is most gratifying to note that during the year the Wrentham branch of the Old Colony, 12 miles long, has been completed without a single grade crossing.

The law passed last year provides that proceedings for the abolition of grade crossings may be instituted by either a municipality or a railway. Of the expense of removal, 65% is borne by the railway and 35% by the state and the city or town; the city's or town's proportion, however, being not more than 10% of the total cost. Since the passage of this act, proceedings have been started by railway companies for the abolition of 37 grade crossings; and cities or towns have begun action for the removal of 30 others, making a total of 67. In this connection the Commission calls attention to the unwise action of the city of Lynn in rebuilding its burned district without removing the grade crossings. Legislative action is recommended to compel the changes to be made while the work can be done at a moderate cost.

The annual report of the bridge expert to the Commission, Prof. SWAIN, shows that only $943,347 was spent in repairing and renewing bridges last year, a less sum than in any year since 1882. The bridges of the state, however, are generally in excellent condition: a great change has taken place since the nondescript structure at Forest Hills caused the fatal wreck in the spring of 1887. During the past 3½ years the Connecticut River road has entirely renewed 28.8% of all its structures; the Providence & Worcester, 42.9%; the Old Colony, 34%; the Fitchburg, 14.9%; the Housatonic, 45.8%, and the Boston & Maine, 21.6%.

ACCIDENT STATISTICS.

The three serious accidents at Quincy, and near Chickering on the Old Colony, and near Winter Hill on the Boston & Maine have increased the number of injuries to passengers in the year ending Sept. 30 to about three times that of last year; and, while in 1889 no deaths were reported, the record for 1890 is 21. A curious feature in the record is that the Boston & Maine reports twice as many passengers injured through their own recklessness as any other road. The Commission is uncertain whether a peculiarly reckless class of persons reside along the line of the Boston & Maine, or whether that company is especially careful, either in reporting such accidents, or in shifting the blame onto the victims.

Massachusetts roads were undeniably unfortunate in the matter of accidents in 1890 and 1887. Still, the showing for 6 years past (which includes these disastrous years) is a very creditable one. It compares as follows with the accidents on British railways in 1889, and with those on United States railways for the year ending June 30, 1889, according to the Interstate Commerce Commission's statistics:

Passengers Killed or Injured from Causes Beyond Their Own Control.

	Killed.	Injured.
Massachusetts, 1885 to 1889, inclusive	1 in 7,852,734	1 in 1,630,763
United States, year ending June 30, 1889	1 in 1,553,133	1 in 220,024
Great Britain, in 1889	1 in 8,808,875	1 in 762.975

The record of accidents to employees shows that falling from cars or engines was the most fatal cause of accident, 23 deaths and 52 injuries resulting from it. Coupling and uncoupling cars caused, as usual, the most injuries, 152 being reported, besides 6 deaths.

Altogether, this year's report of the Commission is an able document, and its members are to be congratulated on their year of hard and faithful work. The report is issued in most readable form, and might well serve as a model in this respect, with the exception of the illustrations. While those accompanying the report of the Quincy accident are excellent, the drawings with the report on fenders for electric cars are full of errors. These were perhaps passed uncorrected because of haste, but they should by no means have been published in the condition they were in.

Hardening Steel Plates.

Experiments have recently been made to ascertain whether it can be confidently stated that oil-hardening and annealing, or some such process, is necessary for steel plates. Messrs. Brown and Messrs. Cammell, the two great Sheffield firms, makers of compound armor, are now satisfied as to this necessity. A 9-in. plate of steel was manufactured and cut into two plates, each 4 ft. square. One piece was left untreated, and the other was oil-hardened and annealed. They were fired at by the 6-in. gun with Firth steel projectiles weighing 100 lbs. The striking energy of the blow upon the untreated plate was 2,389 foot-tons, and the energy of the blow upon that which had been treated was 2,378.5 foot-tons. In the latter case the projectile made an indentation of 10½ ins., so that light was just visible through the center of the bulge at the back of the plate. The projectile rebounded, broken into three pieces. The plate was cracked through, but was whole, and no material was splintered out either at its front or back. In the case of the untreated plate, the shot passed through, and the splintering of the steel around the hole in front of the plate spread over a space of 15 ins. across. The splintering around the hole at the back of the plate covered a space of 33 ins. across. The plate did not remain whole, but went into six pieces.

Progress Report of the Am. Soc. C. E. Committee on Standard Rail Sections.*

The following Progress Report of the Am. Soc. C. E. Committee on Standard Rail Sections accompanies and explains the large sheet of individual designs for rail sections which constitutes an inset for this week. We discuss the report somewhat in another column.

To the President and Members of the American Society of Civil Engineers:

Your Committee on Standard Rail Sections begs leave to submit the following Progress Report:

The committee met at the House of the Society, Oct. 1, 8 members being present and 4 absent (one appointment being vacant), and organized by the choice of G. Bouscaren as Chairman and A. M. Wellington as Secretary.

After some preliminary discussion it was resolved on motion of Mr. Morison that each member of the committee be requested to propose a design, or scheme for, a set of sections, and transmit the same to the Secretary of the committee on or before Dec. 1, 1890, and that the Secretary be requested to canvass these suggestions and report to the committee in what respects they agree and disagree. It was also resolved that these sections be prepared according to the individual preference of each member, regardless of any prior recommendations.

In accordance with this resolution 10 different sets of designs have been prepared and transmitted to the Secretary, submitted by 11 different members, viz.: Messrs. G. Bouscaren, J. Foster Crowell, S. M. Felton, Jr., H. Stanley Goodwin and Samuel Rea, J. D. Hawks, R. W Hunt, Geo. S. Morison, E. D. T. Myers, Thos. Rodd and A. M. Wellington. Mr. V. G. Bogue was appointed on the committee too late to prepare a set of sections, and no set has been received from Mr. F. M. Wilder, the only remaining member of the committee.

The last of these sets of sections was not received until just before the meeting; consequently the committee has not yet been able to take any action upon the report of the Secretary in regard to them. The Secretary's report is subjoined to this report, with engravings of the several sets of sections, and the accompanying memoranda sent in by the members of the committee.

These sections show a fair degree of agreement, considering that they were designed prior to all attempt at comparison of views. The further steps of the committee have not yet been determined on.

REPORT OF THE SECRETARY TO THE COMMITTEE.

To the Committee on Standard Rail Sections:

Agreeably to the vote of instructions passed at the last meeting of the committee, to the effect that each member of the committee be requested to send to the Secretary of the committee a set of sections embodying his own personal preferences or suggestions in regard to a set of standard sections, and that the Secretary report to the Committee in what respects they agree and disagree, the Secretary submits the following report:

Ten different complete sets of designs have been received, from eleven different members of the committee, the only members who have not sent in sections being Messrs. Bogue and Wilder. Full size drawings of these sections are shown on the accompanying sheet. Messrs. Rea and Goodwin submit a set of sections conjointly. The sections appear to show a remarkable degree of uniformity in their main features. In their several details they stand as follows:

1. The late Committee on the Proper Relation to Each Other of the Sections of Railway Wheels and Rails made the following recommendations: (1) 12-in. top radius; (2) ¼-in. corner radius; (3) vertical sides; (4) ⅛-in. lower corner radius; (5) broad head relatively to depth. In regard to these details, the suggestions of the members of the present committee stands as follows:

12-in. Top Radius; ¼-in. Corner Radius; Vertical Sides.—Nine sets of sections out of ten agree with all these recommendations. The set by Messrs. Rea and Goodwin has ⅛ to ⅙-in. corner radius and slightly flaring sides, but retains the 12-in. top radius.

⅛-in. Lower Corner Radius.—All sections have this except that Messrs. Hunt, Rea and Goodwin make it ⅙-in., Bouscaren and Crowell 3/32 in., Hawks a sharp corner; being five for ⅛-in., five for a somewhat larger radius, and one for a sharp corner.

Broad Head Relatively to Depth.—This recommendation being indeterminate, the degree of agreement can best be judged from the sections. It appears to be unanimously accepted in principle, except that Mr. Morison sacrifices it to some extent to obtain the same width of head (2⅛ ins.) for all sections from 50 to 100 lbs., inclusive. Messrs. Rea and Goodwin's sections are also a partial exception.

6. *Total Height.*—The preferences as to this may be tabulated as follows:

Weight of Section.	Bouscaren.	Crowell.	Felton.	Goodwin and Rea.	Hawks.	Hunt.	Morison.	Myers.	Rodd.	Wellington.	Average.
Lbs.											
40	3.50	3.75	3.50	3.50	3.62	3.50	....	3.65	....	3.67	3.58
50	3.87	4.00	4.00	4.00	4.00	4.00	3.95	4.00	4.00	4.00	3.98
60	4.25	4.25	4.00	4.25	4.50	4.25	4.33	4.40	4.25	4.33	4.28
70	4.62	4.62	4.50	4.50	4.75	4.75	4.68	4.73	4.75	4.67	4.66
80	5.00	5.00	5.00	4.75	5.00	5.00	5.00	5.17	5.00	5.00	4.98
90	5.37	5.37	5.50	5.00	5.19	5.50	5.30	5.38	5.25	5.33	5.37
100	5.75	6.00	6.00	5.25	5.50	5.75	5.59	5.68	5.50	5.67	5.47
110	....	....	....	....	....	....	....	....	....	6.00	....

The sections sent in by Messrs. Morison, Myers and Wellington vary in height by some fixed law; all others determine heights arbitrarily. The effort seems to approximate to a uniform variation of ⅛ in. in height for each 10 lbs. per yd. of difference in weight.

Width of Base.—The Goodwin and Rea set of sections has the base ¼ in. wider than the total height throughout. Otherwise the width of base is the same as the total height throughout the sections, with but two partial sections: Mr. Crowell makes the 100-lb. section 5½ in. base to 6 in. high; Mr. Wellington stops widening the base at 5 in. with the 80-lb. section (to and including which the width and height are alike) and retains a 5-in. base for a 90, 100 and 110-lb. section with heights 5⅛, 5⅜ and 6 in. respectively. This is stated to be done for the reason that rails above 80 lbs. demand the use of base plates, for which a 5-in. base is sufficient, while for such heavy sections it becomes increasingly important to have sections well adapted for rolling.

Mean Distribution of Metal, Average of all Sections.

	Head per cent.	Neck per cent.	Base per cent.	Heads vary between
Bouscaren ...	44.5	20.4	35.1	42.7 and 45.3%
Crowell.....	40.8	24.0	35.2	38.7 and 47.5%
Felton.....	42.6	18.7	38.7	39.5 and 44.3%
Goodwin Rea	46.1	19.5	34.4	42.2 and 49.7%
Hawks.....	40.6	22.5	36.9	36.6 and 42.9%
Hunt.....	41.0	20.9	38.1	40.0 and 42.0%
Morison.....	41.5	21.0	37.5	Ratio uniform
Myers.....	43.2	20.7	36.1	40.6 and 44.0%
Rudd.....	44.6	19.0	36.4	44.0 and 46.2%
Wellington..	40.0	22.5	37.5	Ratio uniform
Average....	42.79	20.92	36.59	

The apparent intent in all the sections, the set of Messrs. Rea and Goodwin excepted, was to distribute the metal to head, neck and base in a constant percentage for all sections. Messrs. Morison and Wellington do this explicitly, and Mr. Crowell announces this as a principle though his sections do not exactly agree with it. Messrs. Bouscaren, Felton and Hawks show a tendency to slightly decrease the percentage in the head as the weight increases; Messrs. Goodwin and Rea, to increase the percentage in the head as the weight increases. All other sections (including practically 9 of the 10 sets), tend to a constant percentage regardless of weight, as shown in the following table, showing the percentage of metal in the head of each section. It has not appeared necessary to construct similar tables for the percentages in neck and base:

Percentage of Metal in Head for Each Section.

Weight of Section.	40	50	60	70	80	90	100	Average.
Bouscaren	44.8	(45.0)	45.3	(45.2)	45.0	(44.0)	42.7	44.5
Crowell....	38.7	43.2	40.7	40.9	41.5	41.3	39.2	40.8
Felton....	42.8	42.7	43.7	44.3	44.3	41.1	39.5	42.6
Goodwin-Rea	42.2	42.5	44.6	47.5	46.6	49.5	49.7	46.1
Hawks	42.9	40.8	40.3	40.5	41.9	40.9	36.6	40.6
Hunt.....	40.0	40.7	41.7	41.6	42.0	40.8	40 0	41.0
Morison....	41.5	41.5	41.5	41.5	41.5	41.5	41.5	41.5
Meyers....	40.6	43.4	44.0	43.7	43.7	43.5	43.5	43.2
Rodd.....	44.0	44.0	45.7	45.3	44.4	46.2	44.7	44.6
Wellington.....	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Average...	41.75	42 38	42.75	42.85	43.09	42.88	41.74	42.49

Width of Head.—The preferences as to this may be tabulated as follows:

Wt. of section, lbs. per yard.	Bouscaren.	Crowell.	Felton.	Goodwin and Rea.	Hawks.	Hunt.	Morison.	Myers.	Rodd.	Wellington.	Average.
40	1.87	2.00	2.12	1.78	1.87	1.87	....	1.82	....	2.12	1.94
50	2.06	2.12	2.25	2.12	2.06	2.06	2.50	2.00	2.19	2.25	2.16
60	2.25	2.25	2.37	2.28	2.19	2.19	"	2.20	2.31	2.37	2.29
70	2.37	2.34	2.50	2.47	2.31	2.56	"	2.37	2.37	2.50	2.43
80	2.50	2.50	2.62	2.55	2.50	2.62	"	2.53	2.50	2 62	2.54
90	2.62	2.72	2.75	2.75	2.75	"	"	2.69	2.56	2.75	2.67
100	2.75	2.87	2.87	2.86	"	"	"	2.84	2.81	2.87	2.73
110	....	....	....	....	....	....	....	....	....	(3.00)	....
Total Range 40 to 100 lbs.	0.87	0.87	0.75	1.08	0.87	0.75	none	1.02	0.62	0.75	0.79

Messrs Felton and Wellington submit uniformly varying widths of heads (varying by ¼ in.). All others vary irregularly or (Morison's) not at all.

Depth of Head.—This may be tabulated as follows:

Wt. of sec., lbs. per yd.	Bouscaren.	Crowell.	Felton.	Goodwin and Rea.	Hawks.	Hunt.	Morison.	Myers.	Rodd.	Wellington.	Average.
40	1.06	1.12	1.00		1.00	0.98	....	1.12	....	0.90	1.02
50	...	1.19	1.12		1.12	1.12	1.01	1.23	1.19	1.04	1.12
60	1.33	1.25	1.25		1.25	1.28	1.17	1.35	1.37	1.17	1.27
70	....	1.44	1.37		1.37	1.39	1.34	1.45	1.47	1.28	1.39
80	1.58	1.50	1.50	Not tabulated. See sections.	1.50	1.50	1.50	1.56	1.62	1.39	1.51
90	...	1.56	1.56		1.50	1.56	1.66	1.65	1.81	1.49	1.60
100	1.70	1.62	1.62		1.50	1.70	1.82	1.74	1.78	1.58	1.70

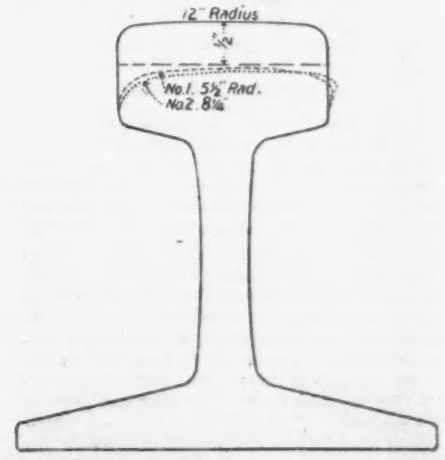
Angle of Base of Head and Top of Base.—All sections have these two angles alike. Messrs. Crowell, Felton and Rodd use 13°; Messrs. Rea and Goodwin, 13½°; Messrs. Hunt, Morison and Wellington, 1 in 4, or 14°; Mr. Myers, 1 in 4½, or 12°; Mr. Bouscaren, 11°, and Mr. Hawks, 11°.

Fillet Radius.—In every case but one this is the same at both top and bottom of the neck. Messrs. Bouscaren Felton Goodwin and Rea, Hawks, Hunt, Rodd and Wellington use ¼ in.; Mr. Myers, ⅛ in.; Mr. Morison a variable radius varying inversely with the weight of sections from 0.37 to 0.19 ins., averaging about 0.27 in. Mr. Crowell uses ⅛ in. for the upper radius, and ⅛ to ¼ in. for the lower radius, the smaller upper radius being stated to be used for the purpose of improving the bearing of the fish-plate.

Radius of Sides of Neck.—Messrs. Morison, Myers and Wellington use straight sides, and Felton 30-in. radius; Messrs. Bouscaren, Crowell, Hawks, Hunt and Rodd use 12-in. radius; and Messrs. Goodwin and Rea 9-in. radius.

Thickness of Neck.—This cannot usefully be tabulated as the sides are not of the same form, and can best be judged of from the sections and the percentages of meta in the neck, as shown above.

Extremities of Base.—These with but one exception are vertical, rounded off with a very short radius at top and



Experiments with Michigan Central 80-lb. Rails with Tops Planed Flat. (Scale, ½.)

Rail No. 1 was used on the outside of a 8 deg. 18-min. curve for 275 days, during which time 63,800 engines and 447,425 cars passed over it, an average of 232 engines and 1,627 cars per day.

Rail No. 2 was used on the inside of a 13 deg. 45-min. curve for 655 days, during which time 200,430 engines and 414,615 cars passed over it, an average of 306 engines and 633 cars per day.

*Presented and accepted at the annual meeting of the American Society of Civil Engineers, Jan. 21, 1891.

bottom, generally 1/16 in. The exceptions in radius are Messrs. HUNT, MYERS and RODD use an upper radius of ⅛ in.; and Mr. MYERS has also a 1/32 instead of 1/16 in. radius at the bottom; Mr. BOUSCAREN has 3/32 instead of 1/16 in. radii. Messrs. REA and GOODWIN round the whole corner of the base.

Mr. J. D. HAWKS, of the committee, submits in the accompanying engraving an experiment made to test the effect of flat and thin heads. Two of the Michigan Central 80-lb. rails had ½-in. planed off their tops, as shown, and were placed on sharp curves. The rail marked "No. 1" was used on the outside of an 8° 18′ curve for 275 days, during which time 63,800 engines and 447,425 cars passed over it, an average of 232 engines and 1,627 cars per day. The rail marked "No. 2" was used on the inside of a 13° 45′ curve for 655 days, during which time 200,430 engines and 414,615 cars passed over it, an average of 306 engines and 633 cars per day. The result upon the shape of the top was as shown.

In explanation of the unavoidable delay in sending out these sections and the above report, the Secretary desires to state that they were held for nearly six weeks after they were substantially complete, to enable members of the committee to complete their sections, a delay which appeared expedient to secure completeness, as it was found that a quorum of the committee would not be present at the annual meeting. As all the sections have been in the custody of the Secretary, he desires to state that his own sections were designed quite independently of the rest, and before he had received most of them.

The sections are not designed for precisely the same area of section for each nominal weight, but as this discrepancy is readily corrected it is neglected in this summary.

Each set of sections is accompanied by a table of dimensions, from which this abstract has been prepared, which it is not deemed necessary to reproduce. The explanatory communications sent in by members with their sections are subjoined thereto.

At an informal meeting of the committee, held after the annual meeting, it was recommended that the Secretary prepare a set of sections averaging as nearly as might be the individual sections, neglecting any wide deviations which appear in one set of sections only. The Secretary's engagements have not permitted him to do this, but a set having the following dimensions would come very near to such an average section:

Head, 12 ins. radius; top corner, ¼ in.; lower corner ⅛ in.; vertical sides; percentage of metal, 41.5% (neglecting both the GOODWIN-REA and RODD sections as erratic); width varying by ⅛ in for each 10 lbs., and as follows:

Weight of section in lbs.	40	50	60	70	80	90	100
Width of head in ins	2.0	2⅛	2¼	2⅜	2½	2⅝	2¾

Neck, 21% of the metal; ⅛-in. top and bottom fillet radii; either straight sides or 12-in. side radius (there appears to be a division of sentiment on this point); thickness as determined by percentage and following dimensions:

Base, 37.5 % of the metal; 13° top angle (as also for under side of head); width same as total height of rail; vertical sides with 1/16-in. top and bottom corner radii.

Total height and width of base varying by ⅛ in. for each 10 lbs. of section, and as follows:

Weight of section in lbs.	40	50	60	70	80	90	100
Total height and width, ins.	3.67	4.0	4.33	4.67	5.0	5.33	5.67
Actual average for do.	3.88	3.98	4.28	4.66	4.98	5.32	5.67

Respectfully submitted,

A. M. WELLINGTON,
Secretary of Committee.

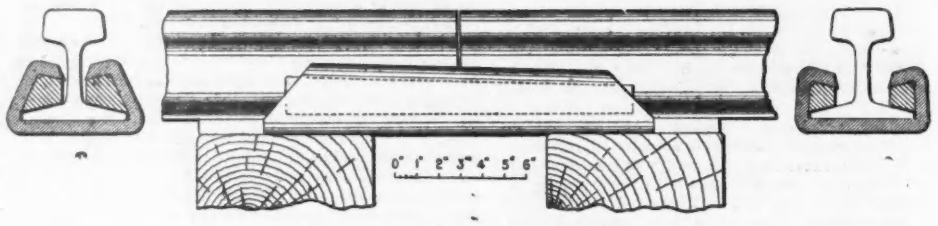
Extracts from the communications sent in by the members of the committee in explanation of their respective designs will be published next week.

The Patterson Rail Joint.

The rail joint shown in the accompanying cut embodies some novel ideas for such a device, and appears to possess some advantages in giving a firm hold to the rail. It is of the bridge type, and dispenses entirely with bolts and nuts. The fastening consists of one or two wedges driven between the flange of the rail and the side of the bridge plate. This wedge system of fastening has been entensively adopted, and with successful results, for securing T-rails to steel ties, and is proposed by Mr. C. P. SANDBERG for securing T-rails to steel tie-plates. The cut shows two forms of the joint, the bridge plate having vertical sides in the one case and inwardly inclined sides in the other case; two keys or wedges are used. A third form is made in which one side of the bridge plate is bent over to hold the rail flange, the other side being either vertical or inclined; with this form only one key is required. The bridge is pressed to shape from a steel plate cut to a template; it is of Bessemer steel, ⅝-in. thick; the floor is 24 ins. long, the sides are 3 ins. high, 18 ins. long at the bottom, the inner side is 10 ins. and the outer side 12 ins. long at the top. The key is of iron, with a taper of 1 in 40; for a bridge plate with vertical sides it is 1¾ ins. × 1⅛ ins. at the large end, and 2 ins. × 1¼ ins. for a plate with inclined side. The bridge plate weighs about 40 lbs., and the keys weigh about 8 or 9 lbs. each. The bridge is spiked to the ties, which are spaced 8 ins. apart in the clear.

On the Western New York & Pennsylvania R. R. some of the single-key joints have been in use for 5 years on a single track line with heavy traffic at low speed, and the results observed are said to have been satisfactory. A trial of the joint is now being made on the New York Central & Hudson River R. R., but for the heavy traffic and heavy engines on that road the double-key joints were considered preferable. There are in the yard at Hudson, N. Y., 9 joints with vertical sides, and 12 joints with inclined sides, all with two wedges. In a report to Mr. KATTE, Chief Engineer of the road, Mr. D. S. GARDINIER, Roadmaster of the division upon which the joint is laid, states that the joints were put on about the end of July or first part of August, 1890, and that nothing had been done to them since. They were put on new rails, and after having been in service about 4 months he found them tight, and saw no reason to condemn them, but the time was too short to decide as to their durability. They are laid an a curved part of the line; those in the down track are in sand and cinder ballast and those in the up track in gravel ballast. Mr. GARDINIER informs us that a careful examination on Jan. 15 showed the joints to be perfectly tight, and in as good condition as when put in.

The joint is the invention of Mr. E. G. PATTERSON, of Titusville, Pa., and is manufactured by the Troy Steel & Iron Co., of Troy, N. Y. The following notes on the general subject of rail joints have been sent us by Mr. PATTERSON, who considers that no joint device can be successful which supports the rail ends entirely by their heads or by a combination support of base and head:



THE PATTERSON RAIL JOINT.

A notable effort in this latter direction is the design of the "continuous" rail joint, in which the flange of the angle bar is made sufficiently wide to permit of its being bent under the rail, to form a base support riding upon two ties. It is still, however, a fish plate, and its service is dependent upon the mechanical possibilities in keeping the bolts tight, and in simultaneously and evenly wearing the three points of contact between the device and the rails. Another joint of a similar type consists of a short, two bolt fish bar, with the rails riding in an independent channel bar covering two ties. These two devices may be taken as types of the efforts to accomplish one result by the application of two conflicting principles; this is an impracticability, and one of the principles must inevitably do all the effective work. As to the class of joints with suspended base support, the original "Fisher" (about 1860), the "Crocker" (about 1862) and the "Reeves" (about 1864) are typical of all of this class whose short-lived service depended upon bolting.

Of the class of joints with supported base support, I think that the "Howe," 1855-1866, contained the best mechanical principle (I recall the Holley publication of about 1868 as the only printed exhibit of the device within my knowledge). It succeeded to a greater degree and came into more general use than any device of its time. Its characteristic was the concentration of the load at the center of a longitudinal support (a plank 2 × 10 × 24 ins.) riding upon two depressed ties. Its weakness was the necessity of constructing it almost entirely of wood. The consequent destructibility and cost of care necessitated its abandonment. Mr. FISHER, in his later device, adopted the Howe theory, though subtituting the U-bolt and nuts for the "Trimble" bar used by Howe, and this substitution necessitated the weakening of his floor by bolt holes at the center, where Howe sought the greatest strength.

My own experiments, commenced in 1864, led me to attempt a rigid joint support, despite the tradition which prescribes elasticity as a necessity, and as I know that each additional part in a joint device is a wearing point, and consequently a source of weakness, my effort has been in the direction of the fewest parts. Three is the extent in the heaviest patterns, as against the 14 and 20 of the long angle-bar joints. I also avoid weakening either rail or joint by perforation of the metal.

Missouri Pacific Railway Bridges.

From a personal letter from Mr. GEO. H. PEGRAM we abstract the following statements as to the advantages of the novel type of trusses illustrated in our issue of last week:

The weakest part of any of the common forms of truss is the end or suspended panel. This is not an integral part of the truss, and the first floor-beam from the pier is suspended from the junction of the end post or top chord frequently by a rod or eye-bar. This receives its maximum strain and a severe shock at every passage of a locomotive. Where drift rises under the bridge it is liable to be buckled and allow the bottom chord to bend upward at this point, pulling the end of the span off the pier. Several bridges have been wrecked in this way. It also provides so little stiffness at the first panel that a derailed train striking the end post is also liable to buckle the bottom chord.

To prevent all this, first-class construction requires that the end suspender shall be made of a riveted post section, and that the two end panels of the bottom chord be also made of a riveted construction. This construction is made imperative by the Chicago, Milwaukee & St Paul Ry., the Pennsylvania R. R., Atchison, Topeka & Santa Fé R. R., the Gulf, Colorado & Santa Fé Ry. and other lines.

In the PEGRAM truss this first panel is naturally the strongest in the bridge and needs no special strengthening. It is the foot of a main post, like all of the other panels.

The floor is the part of a bridge that receives the impact of a train, and the heavier this is the less will be the shock to the truss.

The floors designed by Mr. PEGRAM are the heaviest put in bridges, some of the weight in the expensive trusswork being transferred to the cheaper floorwork. Mr. PEGRAM continues:

The economy of the truss, however, is so great that the total weight of the bridge is less than any other plan, and it also is of a cheaper construction than other trusses, through the smaller number of parts and greater duplication of these.

Some people believe that if a bridge is lighter it is also weaker, but it is a fair presumption that all spans conforming to the same specifications; are equally strong and any additional excellence must be due to provision to meet abnormal strains, as derailed cars, temperature strains, drifts, etc.

The floor beams are held firmly between the pins of the trusses, and there is a double system of bottom lateral bracing riveted to the chords, to the tops of the stringers and at their intersections; each system being made strong enough to meet the specifications even if the other is left out entirely.

The bottom of the bridge is a rigid, riveted network of iron, and would support a train if by any possibility it should break through the ties. If a log were to strike the end of a floor-beam its shock would be resisted by the whole bridge. Also if drift should rise under the bridge it must be resisted by the whole bridge.

If a post is struck the arch of the top chord will transfer the stress to the neighboring posts, as the whole span must be lifted to pull the top chord joints out of line. This arch also serves to lessen the temperature stresses.

On the inset sheet published in our last issue an error was made in the drafting room which is too evident to deceive any one, but may as well be corrected.

The explanatory note to the 150-ft.-span bridge says: "Strains are given in 1,000s of *feet*." This should of course have been "1,000s of *pounds*."

Legal Decisions of Interest to Engineers.

Guaranty in Building Contract.—Where a building contract specifically makes the plans and specifications for the work to be done a part of the contract, a guaranty contained in the specifications binds the contractor the same as if it was actually incorporated into the contract itself. An absolute guaranty that the work, to be done according to the specifications and direction of a supervisor's knowledge, will remain in good condition for a year, is broken if the work fails to remain in good condition for a year, even though the failure did not result from defective material or imperfect workmanship. Under such a guarantee the contractor accepts responsibility for the specifications and supervision. (City of Lake View v. MacRitchie, Supr. Ct. Ill., 25 N. E. Rep. 662.)

Injury of Laborer on Gravel Train.—In an action against a railroad company for personal injuries, a complaint which alleges that the plaintiff was employed as a laborer on a gravel train, and that he was ordered by the foreman to uncouple two cars of the train and then to jump from one to the other while one or both were in motion; that when he attempted to do so the foreman, without warning, let off the brake and thus increased the risk so that when plaintiff jumped he fell between the cars and was injured. It further alleged that this work was not in the line of the plaintiff's employment, that he had no experience on it and was not acquainted with the inherent danger, but did as he was told for fear of being discharged, states a cause of action. (Erickson v. Milwaukee, L. S. & W. Ry. Co., Supr. Ct. Mich., 47 N. W. Rep., 237).

Liability of City for Defective Streets.—A city charged with the duty to keep its highways in repair, and having no provided by taxation to discharge it, will be liable for negligence in its performance, if injury results. Actual possession by the city and user by the public are sufficient to show that the place is a street, without proof of formal dedication. A city is bound to keep its streets in condition of reasonable safety by night as well as by day. Notice of a defect in a street may be inferred from long continuance thereof. Failure to repair such defect after notice and reasonable opportunity is evidence of negligence. Knowledge of such defect by a pedestrian injured thereby is not necessarily a bar to recovery, where the defect is not of such nature as to render the use of the street necessarily dangerous. The issue of contributory negligence on the facts was for the jury. (Maus v. City of Springfield, Sup. Crt. of Missouri, 14 S. W. Rep., 630.)

PERSONALS.

Mr. ECKSTEIN NORTON, President of the Louisville & Nashville R. R. Co., has resigned.

Mr. H. K. ENOS, President of the Missouri, Kansas & Texas Ry., died in New York, Feb. 19.

Mr. J. W. PEARL has resigned his position as Engineer of the Massillon Bridge Co., Massillon, O.

Mr. CHARLES V. MEHLER has been appointed City Engineer of Louisville, Ky., to serve during the unexpired term of Mr. R. T. SCOWDEN, resigned.

Mr. WM. O'HARA SCULLY, Treasurer of the Monongahela Gas Coal Co., died at Pittsburg, Pa., Feb. 10. He was the inventor of the Scully truck for use in low tunnels and for the transportation of machinery, plates, etc., higher than a box car.

Mr. H. H. FILLEY, Chief Engineer of the Mexican National Construction Co., has returned from Tehuantepec to the city of Mexico He has been in Mexico for the past six months erecting 2 bridges on the Interoceanic Ry., and has recently inspected the bridges on the Tehuantepec Ry. He will return to Kansas City, Mo., in March.

Mr. E. C. SMEED, Engineer of Maintenance of Way of the Union Pacific Ry., has been appointed Chief Engineer of the road, to succeed Mr. V. G. BOGUE, who will proceed to the Pacific Slope to attend to important matters relating to the Portland & Puget Sound Ry., which is to be built and operated jointly by the Union Pacific and Great Northern companies.

SOCIETY PROCEEDINGS.

American Institute of Electrical Engineers.—At the meeting, on Feb. 24, Mr. O. T. Crosby, of Boston, will read a paper on "Data and Results of Experiments with Electric Traction at 120 miles per hour." A working model of an electric railway made by Thos. Davenport in 1837 will be exhibited in operation, and will be described by Mr. F. L. Pope.

The New York State Road Improvement Association will hold its second annual meeting in Syracuse on Feb. 24. This is a people's movement, and all citizens having an interest in this matter are invited to attend. Besides general business on this subject the meeting will consider the road bills now before the New York Legislature, particularly the Richardson bill, commended by Governor Hill in his last message.. For further information address Mr. Isaac B. Potter, Secretary, 278 Potter Building, New York City.

Southern and Southwestern Ry. Club –At the meeting at Atlanta, Ga., Jan. 15, about 25 members were present. The subjects discussed were, "Relative Merits of Rigid and Swing Motion Trucks" and "Brake-Beams Hung from Car Bodies vs. Those Hung from Trucks."

On the first topic Mr. A. Steinbrenner said he had failed to find any proof of less flange wear on swing motion trucks, while every one admitted that they cost more to build and maintain. Records of the American Refrigerator Transportation Co. show about the same percentage of sharp flanges on rigid and on swing motion trucks, nor is there any perceptible difference in the end wear of brasses or collars of journals. Further, the swing motion shortens the life of springs and draft gear, and he believed it to be the undiscovered source of many wrecks. The A. R. T. Co.'s equipment consists of 650 rigid truck cars and 550 swing motion. Average annual mileage is 24,000. The records for 5 years show that 80% of the expense for repairs has been applied to the swing motion cars. Shippers greatly prefer the rigid truck cars. He favored anti-friction side bearings as a means of improving the rigid truck.

The swing motion truck was defended by Messrs. Charpiot, McGee, Howson and Cullen.

On the second topic for discussion a paper was contributed by P. Leeds, Superintendent of Motive Power of the Louisville & Nashville, favoring the hanging of brake beams to the truck frame except where the brakes can be placed on the inside of the wheels. The paper and discussion will be found in another column.

American Society of Civil Engineers.—At the meeting on Feb. 18, Vice President A. Fteley in the chair, the Secretary stated that a letter had been received from Mr. Wm. P. Shinn, Past President, urging all members to vote one way or the other on the proposed new constitution, so that a fair expression of the opinion of the society may be obtained. The Secretary then read a paper by Mr. John R. Freeman on "The Nozzle as a Water Meter." The paper described tests that had been made. It was claimed that very accurate results could be obtained, and that this method would be very valuable in tests of pumping engines. The nozzle should have smooth, tapering sides, with sides inclined at an angle of 5° to 7° with the axis. Mr. Fteley thought that if the method proved reliable in practice it would be of great value in testing pumping engines. Mr. Brush thought that for new engines the plunger calculation would be sufficient, but if the use of a nozzle as a meter gives reliable results it would be of advantage for subsequent tests to ascertain the slip of the pump from time to time, but the apparatus must be such that it can be attended to by the regular employees at the pumping station. He stated that in order to test the efficiency of this method in practical work, and not merely as an experiment, he proposed to have one put in at water-works under his charge, and to have it in regular use for a considerable time.

Civil Engineers' Club of Cleveland, O.—Regular meeting of Feb. 10, Vice-President Gobeille in the chair and 17 members and 2 visitors present. Mr. W. W. Kingsley, Assistant Engineer of the city water-works, read an interesting paper on "Notes and Surveys on the Cleveland Water-Works Tunnel." The original location was in a straight line from the shore shaft to the crib in the lake, but, on account of striking quicksand, detours were made, thus complicating the location. On account of the unequal settling of the crib, throwing the shaft out of plumb, the direction of the tunnel at that end was obtained from two plumb lines only 6 ft. 4 ins. apart, yet the intersection of the centers of the two headings was only 6 ins. north of the calculated point of intersection, showing the crib end of the tunnel only nine-tenths of an inch east of its calculated position. The measured length of the tunnel was $\frac{35}{1000}$ of a foot shorter than the calculated length in a distance of over 7,100 ft. After the completion of the tunnel test levels were run connecting the bench marks of the shore end with the lake end, and they were found to differ by only $\frac{15}{1000}$ of a foot. The map also showed the location and soundings for the proposed extension of the tunnel 2¼ miles further into Lake Erie. Specimens of wood, bark and nuts were shown that were found at depths of 60 to 80 ft. below the surface.

A. H. PORTER, Secretary.

New England Railroad Club.—At the meeting on Feb. 11, the subject discussed was, "The Painting and Varnishing of Railway Rolling Stock," opened by Mr. Chas. Richardson, who emphasized the importance of abundant time and the use of pure linseed oil and paints of best quality in order to obtain the best results. He commended the work of test departments as a step in the right direction. Among other facts of interest brought out were that varnish should be well rubbed in. Two coats with rubbing were better than three without. As to the quality of white lead, the formation of the Lead Trust has stopped the rivalry between different manufacturers, and there may not be as much care taken as formerly to avoid careless grinding or corroding. Car cleaners often ruin paint by using too hot water, or ammonia or other acid or alkaline substances. It pays to have a practical painter at the head of a car-cleaning force.

It was stated that in England 3 months is the minimum time allowed for painting a passenger car, and no varnish maker will guarantee varnish to stand with less than 6 weeks drying. Some discussion took place over the relative merits of painting cars light or dark colors, and it was stated that two trains of passenger cars painted pure white are to be put on the New York & New England R. R. The cars of the London & Northwestern Ry. are painted white above the window . . A patented composition, which was commended for painting, is composed of equal parts of white lead, zinc and silex.

At the next meeting on March 11 the subject for discussion will be "Screw Stay Bolts for Locomotives." This will be the annual meeting, and the election of officers will take place.

Engineers' Club of Philadelphia.—Record of regular meeting, Feb. 7, 1891, Past President Rudolph Hering in the chair; 18 members present. Mr. C. H. Haupt presented an illustrated paper on "Photographic Surveying," of which the following is an abstract: The location of points horizontally and vertically from photographs depends, in the first place, on the determination of the position of the point of sight for any view which is at a constant distance equal to the equivalent focus of the lens, and directly opposite the center of the picture. The horizontal projections of jump from may now be connected with this point of sight, and horizontal angles thus determined. Vertical angles for heights are determined from their tangents. Triangulation of any point in the field may thus be effected; as it is possible to measure the true angle between this point and some other fixed point from two views taken from different stations.

A photographic map of the Schuylkill and Fairmount Park was shown. The map was made from photos taken from each side of the river. A panoramic view of the horizon was taken from each station, each view being oriented from the compass bearing of its center. The base line was on the west bank and was 947 ft. long. A check station was taken on the west bank. The scale used was 200 ft. to 1 in., and points platted to this scale from the three principal stations checked exactly. Heights also checked up satisfactorily. The field work took but eight hours; platting about three days.

The Secretary presented, for Mr. J. M. Stewart, a paper by Mr. J. Bernard Walker upon a "Boltless Rail Joint." Mr. Stewart, who is Chief Engineer of the Oregon Pacific R. R. Co., is about to try it on his road, and considers that one of its principal values is that such rail joints will be cheap to maintain, as the constant tightening of bolts is not, in his opinion, necessary.

HOWARD MURPHY, Secretary and Treasurer.

New York Railroad Club.—At the meeting on Feb. 19, about 50 members were present. A paper was read by Mr. Samuel Porcher, of the Motive Power Department of the Pennsylvania R. R., on "The Best Diameter of Car Wheels." He favored a 36-in. wheel as giving on the whole the best service for its cost. In the discussion which followed, opinions seemed to be about equally divided between the 36-in. and 38-in. wheels. Later the discussion drifted on to the relative merits of cast-iron wheels and steel-tired wheels. Mr. Adams, of the Boston & Albany, said that the average life of 33-in. steel-tired wheels in service under passenger cars on the Boston & Albany was 300,000 miles. From 50 to 60% of the wheels removed from passenger cars after this service were put under freight cars, and most of them are still running. Various kinds of wheels are used. The paper wheel and the English wheel with wrought-iron center have been largely used. The company has 16 of the Fowler rolled steel wheels. They have done fair service, but nothing like what Mr. Adams expected. The 42-in. wheel makes a somewhat larger mileage than the 33 in., but not enough larger to pay for its extra cost, nor is the wear on the tire less in proportion to its larger diameter. Another advantage of the 36-in. wheel is that the car body is considerably lower. Also, when the tire is worn to the minimum safe thickness of one inch the wheel can be used in freight service with 33-in. wheels.

Mr. Adams also referred to the prevalent idea that a car with 42-in. wheels rides more easily than a car with 33-in. wheels. He was not prepared to say that this might not be the case on a rough track; but on a well ballasted roadbed, with cars properly hung, he did not think one man in a thousand could tell by the riding of a car whether the wheels were large or small.

Mr. Porcher said that, in comparing the economy of steel and cast-iron wheels, the great difference in cost should be considered. The average life of a cast-iron wheel on the Pennsylvania R. R. is 60,000 miles. Its total cost, crediting its scrap value, is a little less than $5. On a Western road steel wheels make 300,000 miles. At this rate the cast-iron wheel is certainly the cheaper.

Mr. Adams said that safety as well as economy was the motive of the Boston & Albany in using steel-tired wheels. In 20 years' experience no accident has ever been caused on the Boston & Albany by the failure of a steel wheel.

A paper was then read by Mr. P. H. Griffin, President of the New York Car Wheel Co., on "Recent Improvements in Car Wheels," describing the refinements in the process of manufacture in use by the New York Car Wheel Co.

The paper was discussed by Mr. Whitney, of the firm of A. Whitney & Sons, of Philadelphia, and Mr. Snow, of the Ramapo Wheel & Foundry Co. It was hardly as exciting as the last discussion on car wheels before the club in January, 1889, although considerable matter of interest was elicited. An abstract will be given next week.

The next meeting will be held on March 19; subject to be announced.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

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M. N. Baker, F. P. Burt, }
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COMING TECHNICAL MEETINGS.

Engineers' Club of Philadelphia.—Next meeting, Feb. 21. Secy., Howard Murphy, 1122 Girard St.

Denver Society of Civil Engineers.—Next meeting, Feb. 24. Secy., Geo. H. Angell.

Association of Provincial Land Surveyors of Ontario.—Next meeting at Toronto, Feb. 24 Secy., A. J. Van Nostrand, Toronto.

American Society of Mechanical Engineers.—Reunion, Feb 26. Secy., F. R. Hutton, 12 W. 31st St.

Civil Engineers' Society of St. Paul.—Next meeting, March. 2. Secy., G. L. Wilson.

Western Society of Engineers.—Next meeting, March 3. Secy., J. W. Weston, 280 La Salle St., Chicago.

Engineers' Club of St. Louis.—Next meeting, March 4. Secy., Arthur Thatcher, Room 891, Odd Fellows' Building.

American Society of Civil Engineers.—Next meeting, March 4. Secy., Francis Collingwood, 127 E. 23d St., New York.

Technical Society of the Pacific Coast.—Next meeting March 6. Secy., O. von Geldern, 408 California St., San Francisco.

Northwest Railroad Club.—Next meeting, March 7. Secy., H. P. Robinson, St. Paul, Minn.

Engineers' Club of Kansas City.—Next meeting, March 9. Rooms, Baird Building.

Civil Engineers' Club of Cleveland.—Next meeting, March 10. Secy., A. H. Porter, 50 Euclid Ave.

Civil Engineers' Association of Kansas.—Next meeting, March 11. Secy. J. C. Herring Wichita, Kan.

New England Railroad Club.—Next meeting, March 11. Secy., F. M. Curtis.

Engineering Association of the Southwest.—Next meeting, March 12. Secy., Olin H. Landreth, Vanderbilt University, Nashville, Tenn.

Northwestern Track and Bridge Association.—Next meeting, March 18. Secy., D. W. Meeker, St. Paul, Minn.

Western Railway Club.—Next meeting, March 17. Rooms, Phœnix Building, Chicago. Secy., W. D. Crosman, 816 Rookery Bldg.

Engineers' Society of Western Pennsylvania.—Next meeting, March 17. Secy., S. M. Wickersham, Pittsburg, Pa.

Boston Society of Civil Engineers.—Next meeting, March 18. Secy., S. E. Tinkham.

Engineers' Club of Cincinnati.—Next meeting, March 19. Secy., J. F. Wilson.

New York Railroad Club.—Next meeting, March 19. Rooms, Grand Central Depot. Secy., H. G. Prout.

A GENERAL INDEX TO ENGINEERING NEWS, extending from the first issue of Volume I., in 1874, to the end of Volume XXIV. (July–December, 1890), is now in press, and will be issued about March 15, in a separate small volume, handsomely bound in cloth, which will be sold at $1. It will prove a valuable work of reference even for those whose files are not complete.

AT the meeting of the Boston Society of Arts on Feb. 12, a lecture on Aluminum was delivered by Mr. ALFRED E. HUNT, President of the Pittsburg Reduction Co., giving the latest information of the developments in both the production and use of the metal. The extravagant and erroneous statements concerning aluminum, of which the daily press has been full, and which have been largely copied by many of the technical and trade journals, have greatly misled the general public. Many engineers, even, of considerable reputation, have contracted rather extravagant ideas of aluminum and its possibilities through these misstatements. Mr. HUNT has already, in conjunction with Messrs. LANGLEY and HALL, prepared a valuable paper on aluminum, which was printed in our issues of Feb. 22 and March 1, 1890. His present paper discusses the subject, however, from a somewhat different point of view, and is intended to correct some of the prevalent fallacies concerning the metal. The paper will be published in our next issue.

PERHAPS the most interesting part of Mr. HUNT's paper is his discussion of the probable cost of manufacturing aluminum by the electrolytic method (that used by the Pittsburg Reduction Co.) when operated on a very large scale. So much has been published about wonderfully cheap methods of aluminum production, which have proved most elusive on investigation, that it is of much interest to see what are the possibilities of the process by which the price was first brought to a reasonable figure. The following is Mr. HUNT's statement of the theoretical cost per pound of manufacture of aluminum on a large scale by the electrolytic method:

2 lbs. alumina (Al_2O contains 52.94% Al_2) at 3 cts.....	$.06
1 lb. of carbon electrode at 2 cts.....	.02
Chemicals, carbon dust, and pots.....	.01
2½ electrical HP. exerted one hour (water-power being used).....	.05
Labor and superintendence.....	.03
General expense, interest and repairs.....	.03
Total cost of one pound of aluminum.....	$.20

Of course the cost of production by the small plant of the Pittsburg Reduction Co., with a capacity of but 375 lbs. of aluminum per day, is very much larger than this; but the estimate is highly instructive, as showing how low is the theoretical cost of production by the electrolytic process. "Undoubtedly," says Mr. HUNT, "as the most economical methods are used, figures approaching these will be attained." In our issue of Nov. 8, 1890, an estimate of the cost of aluminum production was made in which the figures correspond quite closely to those of Mr. HUNT. We then concluded that aluminum would be produced in a few years at a cost as low as the present price of tin, and perhaps as cheaply as copper is now sold. As Mr. HUNT indicates the possibility that some of the items in the above estimate may be slightly reduced, it will be seen that the reduction of aluminum to a price approaching that of copper is by no means impossible. In considering the relative cost of aluminum and other metals, its low specific gravity should not be forgotten. Reckoning bulk for bulk, aluminum at 57 cts. per lb. is as cheap as copper at 16 cts.; and at 64 cts. per lb. it is as cheap as tin at 23 cts.

WE begin in this issue a short series of articles on artesian well practice in the western United States, which are of especial interest and value. The articles will be based upon the excellent preliminary government report, reviewed last week, on "The Proper Location of Artesian Wells within the Area of the 97th Meridian and East of the Foot Hills of the Rocky Mountains," which is one of the most complete, in fact, the only report approaching completeness, regarding the number and characteristics of artesian wells in any section of the United States, and with the possible exception of French Government reports it is probably the most complete report of its kind ever issued. In the area investigated it appears from the report that there are at least 2,500 flowing artesian wells. West of the limits of the investigation the number of flowing wells in various groups is stated, making a total of 6,400 more, or nearly 9,000 flowing wells in the western part of the United States. Several hundred of these wells and many non-flowing wells are described in detail in the report, thus affording a vast amount of valuable matter regarding the technical details of artesian well practice. It was not within the scope of the report to digest these technical details, and, as it would probably otherwise remain undone, we propose to do this work for the benefit of our readers in the series of articles which begins with this issue. The investigation was ordered by the United States Senate, and carried on by the Department of Agriculture to determine the present and possible future relation of artesian wells to agriculture. It was really an investigation of subterranean waters, which can be brought to the surface by giving freedom to their natural pressure or by pumping. The importance of the relation of such waters to agriculture can better be realized when it is stated that Mr. R. J. HINTON, special agent in charge of the investigation, estimates that 200,000,000 of the world's inhabitants are dependent for their food supply upon land irrigated with water derived from underground sources.

THAT brake beams on freight cars should be hung from the truck frame is a matter that has been frequently urged. The able report on "Standard Brake Gear for Air-Brake Cars," made by a committee of the M. C. B. Association in 1889, discussed the matter at some length and summed up by saying that the objections to hanging brakes from the car body were inherent in the principle and could not be overcome.

In a paper by the superintendent of motive power of the Louisville & Nashville R. R., published elsewhere in this issue, this subject is further discussed, and evidence is given that the practice of hanging outside brake beams from the car body has been a fruitful source of accident. This statement is corroborated by Mr. E. S. MARSHALL, Gen. Master Mechanic of the St. Louis, Arkansas & Texas, who gives conclusive testimony as to the effect of body-hung brakes in causing derailment. If any really weighty reason exists for placing brake beams on the outside of the wheels and hanging them from the car body, we are not aware of it. This is one of the cases where it seems to cost practically no more to do a thing in the best way than to do it in a defective and dangerous way. When brake beams are hung from the car body the distribution of the load to the front and rear axles of the truck is materially disturbed, to an extent which may easily lead to accident, and still more easily to slipping of wheels. The pressure of the leading wheel of the rear truck upon the rail, with outside body hung brakes, may be decreased 20 per cent. or more by the action of the brakes, and this lifting force does not act as a steady pull, but is jerky and variable. This lessening of the pressure on the rail may either cause the wheel to slide and produce a flat spot, or, as stated by Mr. MARSHALL, it may help the wheel to mount the rail. The lifting action of the brakes on the leading wheel of the rear truck increases as the trucks are brought closer together, which goes far to explain why the derailments noted on the St. Louis, Arkansas & Texas occurred chiefly on tenders.

A MUCH heralded series of experiments is now in progress in this city on the important question of whether roast beef or roast mutton is really the best kind of food, or rather—we beg the advisory committee's pardon—on whether machine

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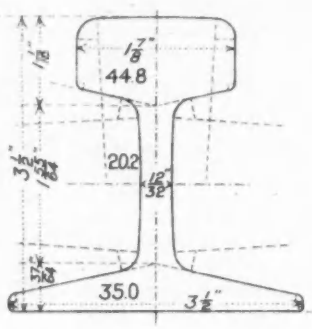
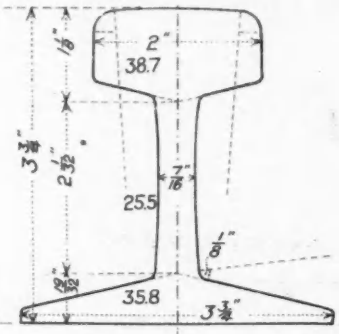
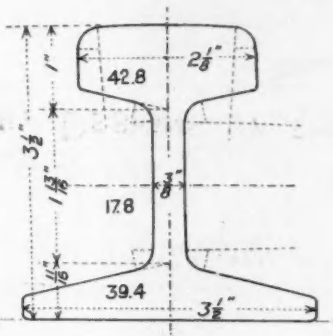
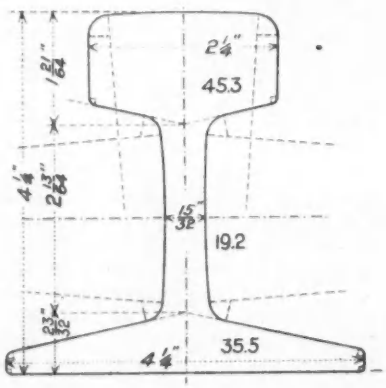
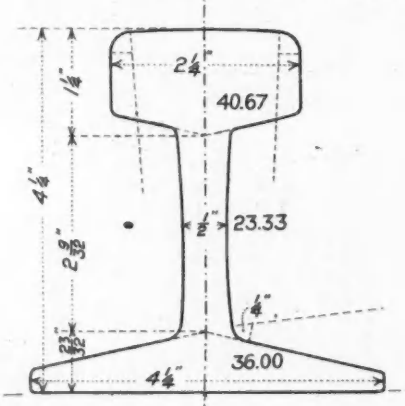
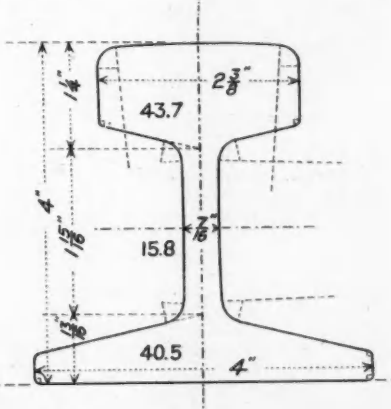
40-LB.			
50-LB.			
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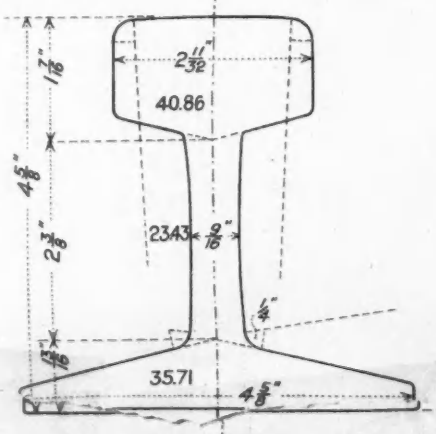
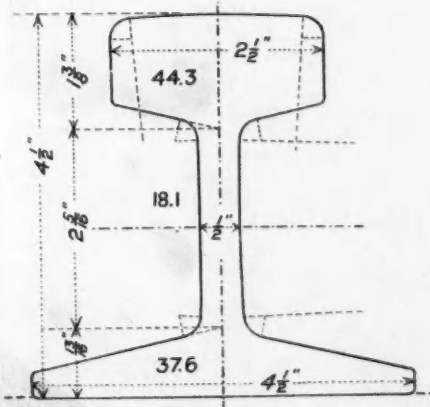
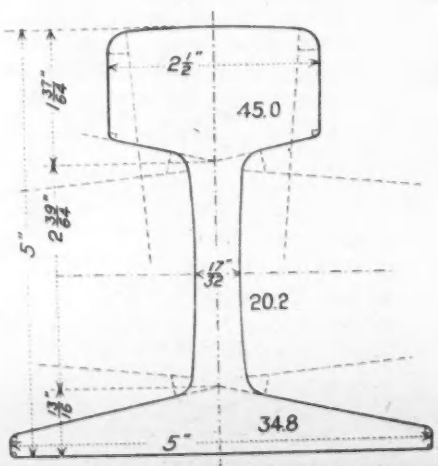
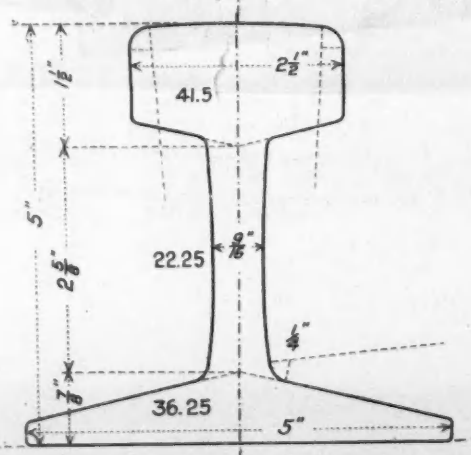
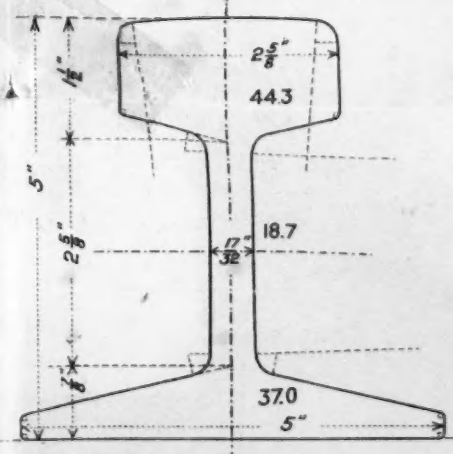
70-LB.			
80-LB.			

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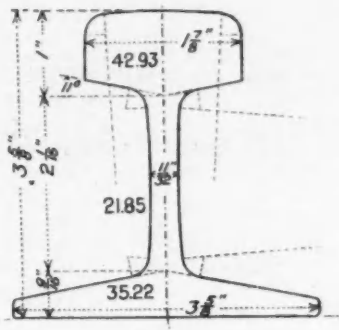
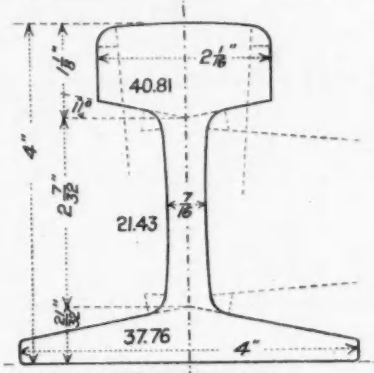
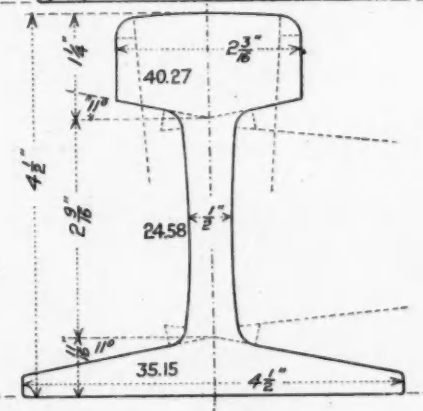
EXPLANATORY NOTE.—The several designs for sections of any one given weight are in horizontal rows; the several designs by each member of the Committee in vertical columns.

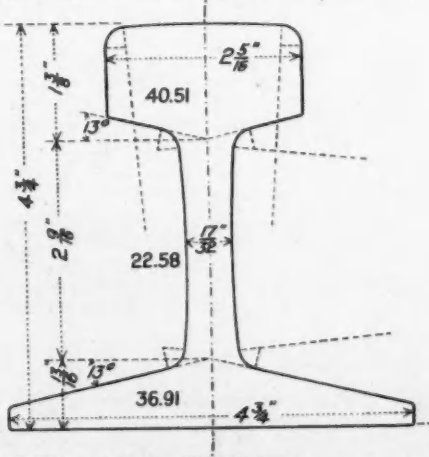
The dimensions which are common to the sections of all weights in each set of sections are shown on the 100-lb. section only. The dimensions which are not common to all sections are the only ones shown on the sections lighter than 100 lbs.

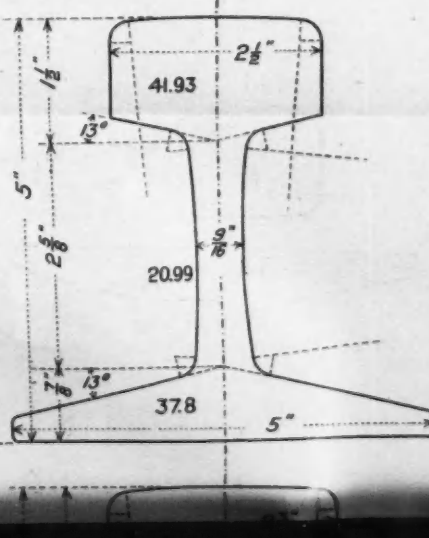
J. D. HAWKS.



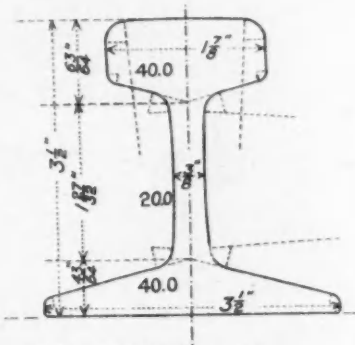


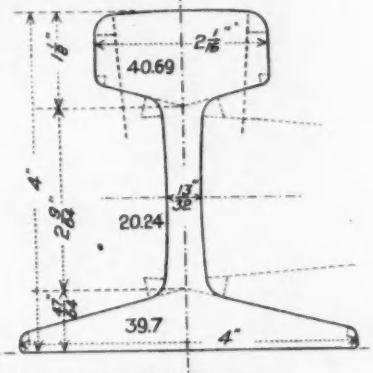


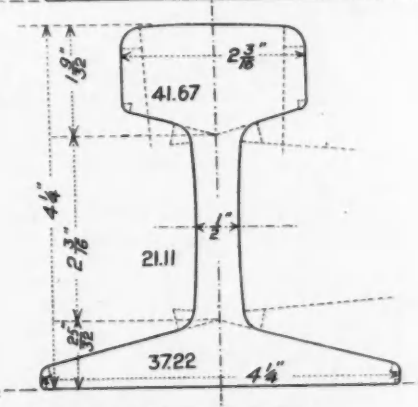


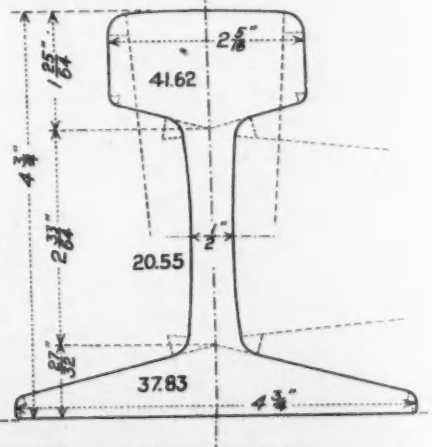


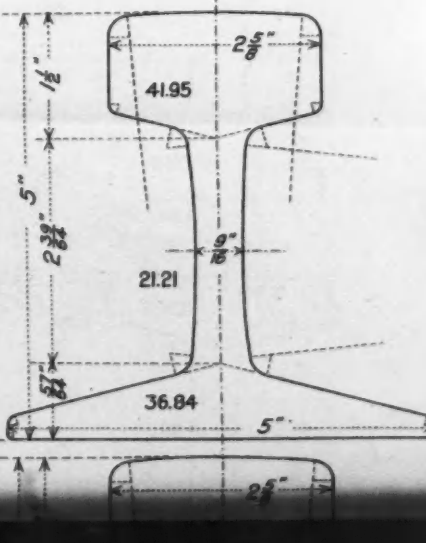
R. W. HUNT.



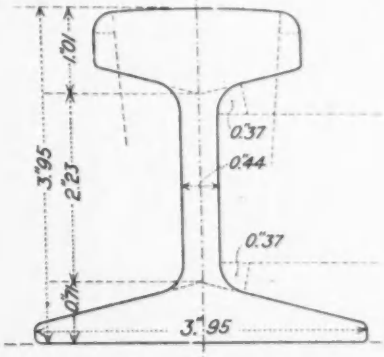


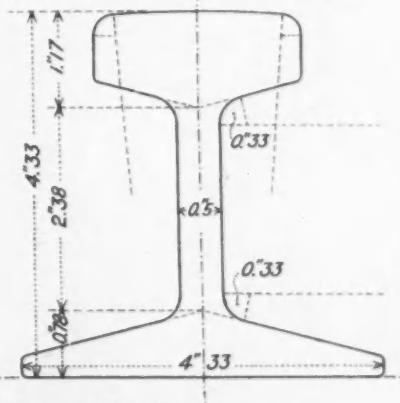


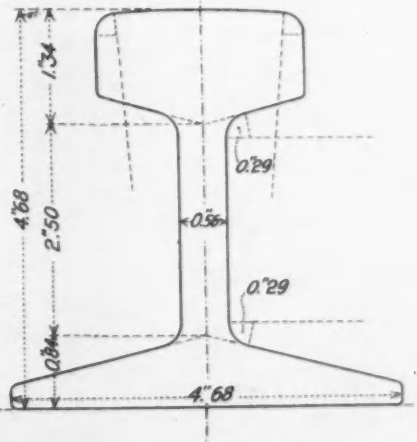


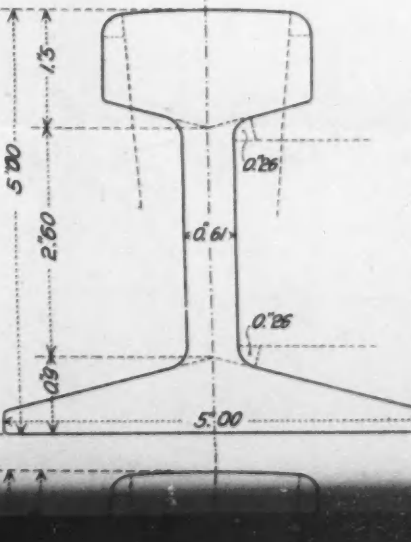


GEO. S. MORISON.







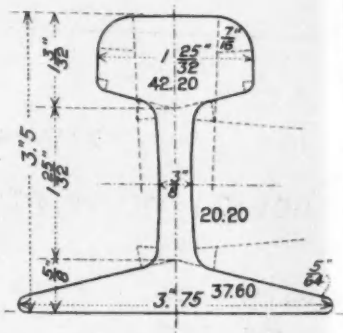
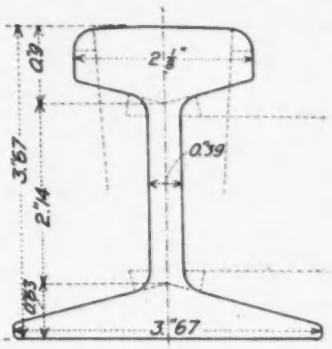
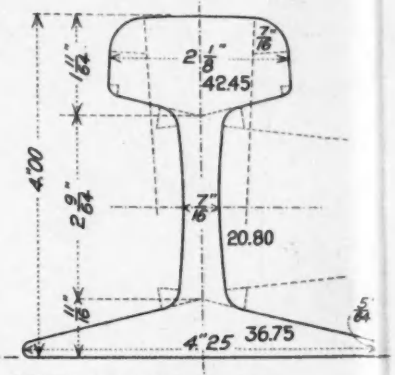
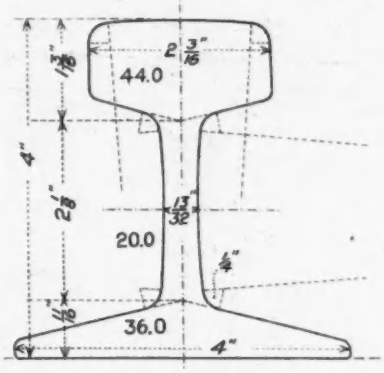
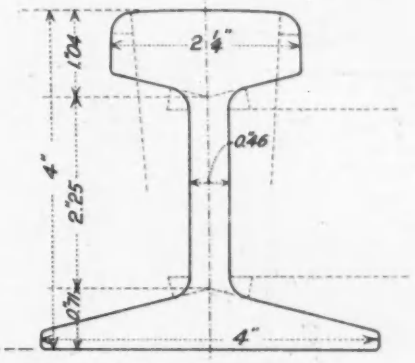
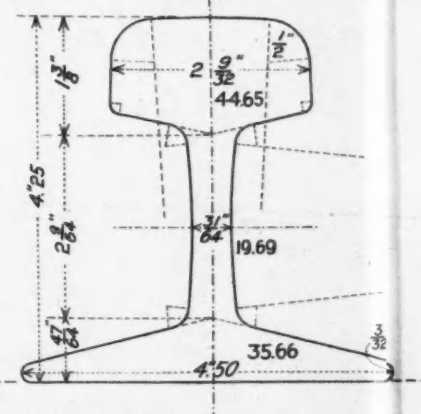
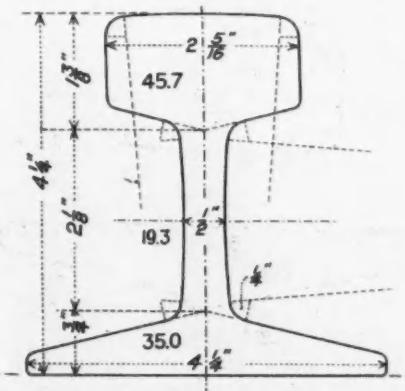
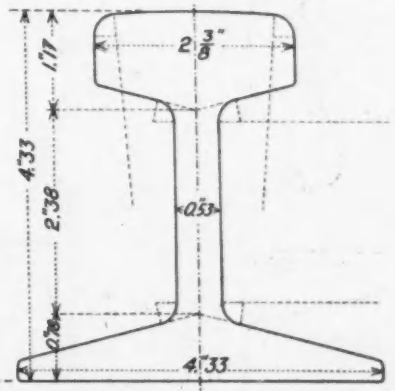
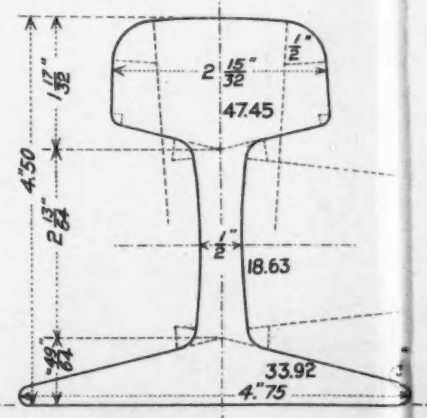
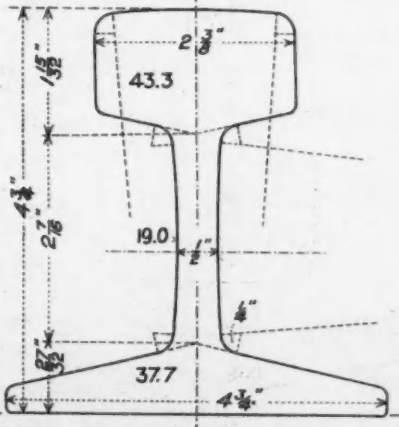
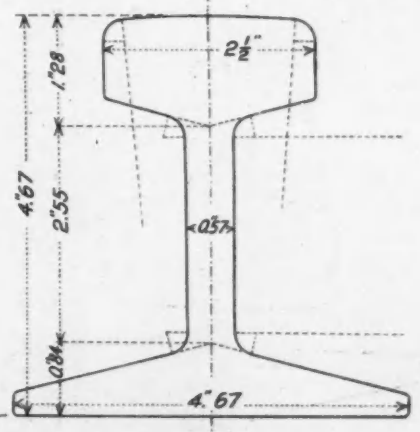
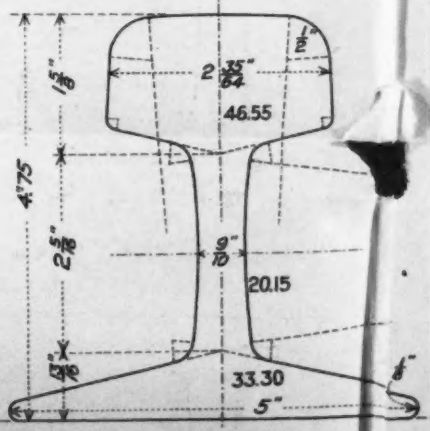
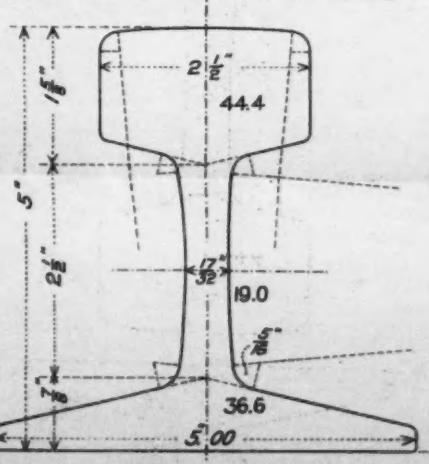
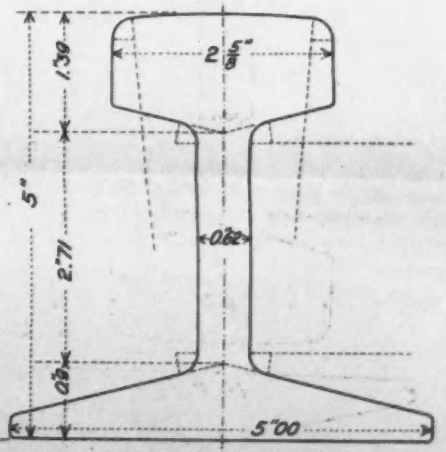


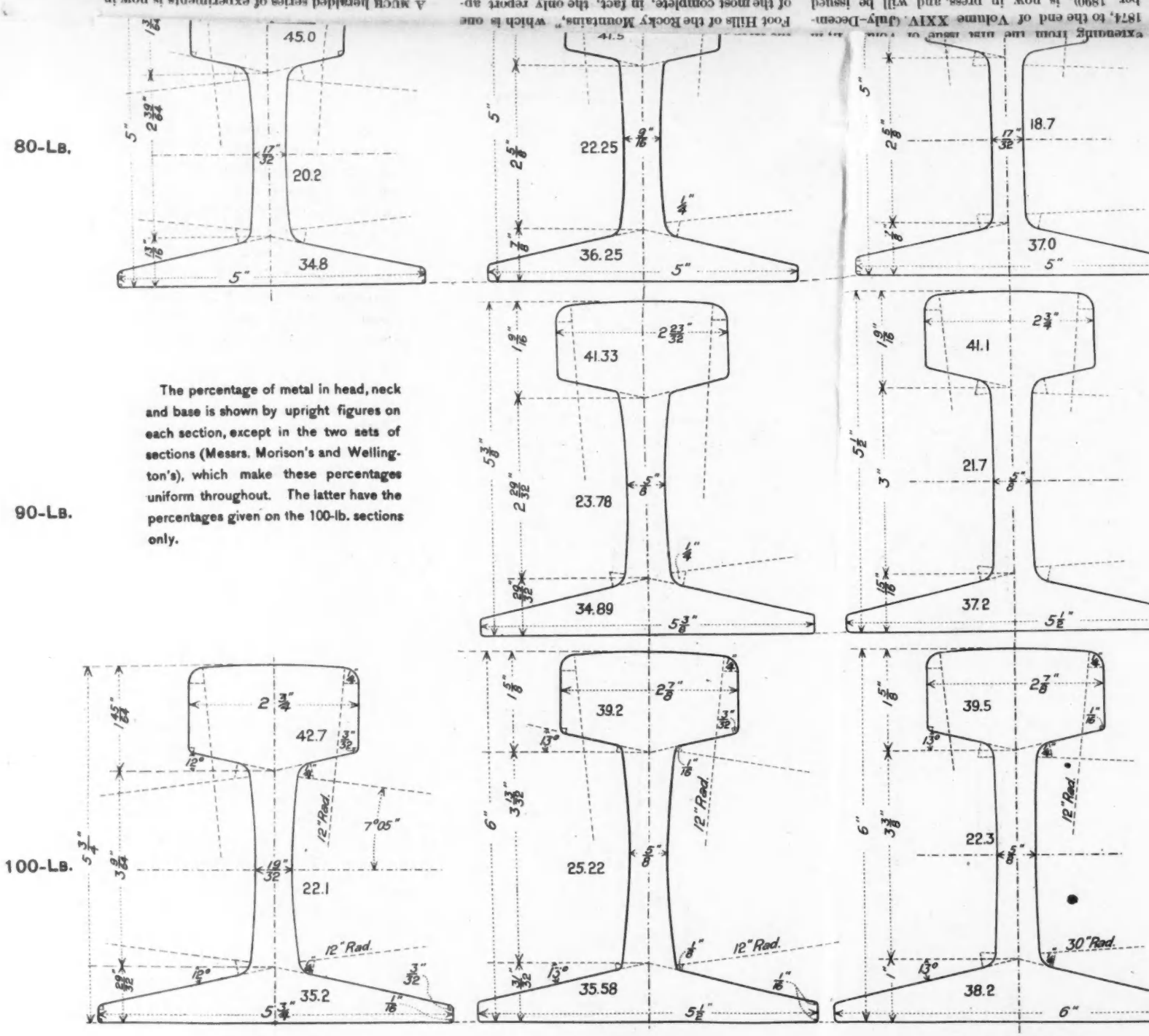
WKS.

R. W. HUNT.

GEO. S. MORISON.

E. D. T. MYERS.

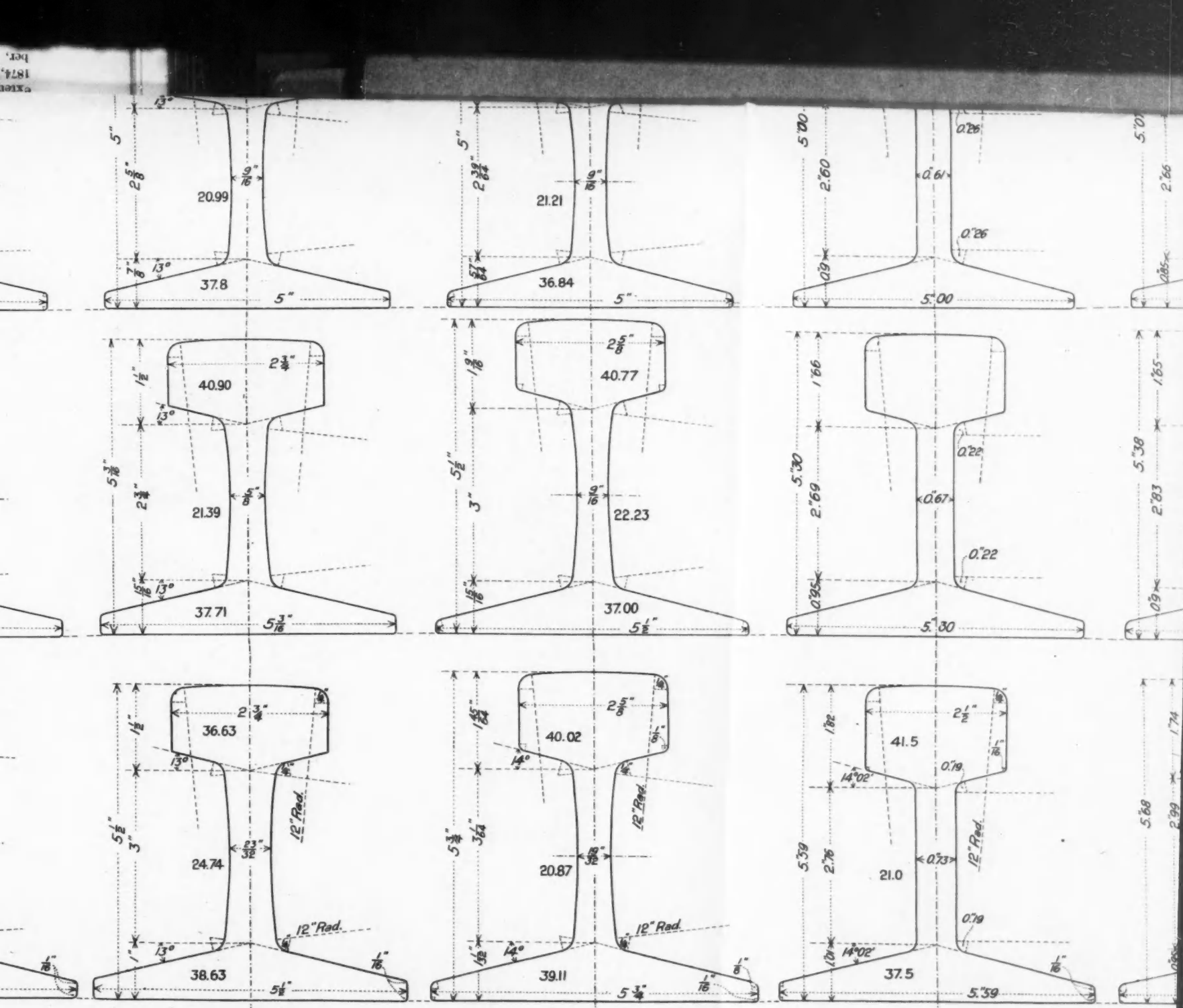
SAMUEL REA. H. STANLEY GOODWIN.	THOS. RODD.	A. M. WELLINGTON.	
			40-LB.
			50-LB.
			60-LB.
			70-LB.
			80-LB.



The percentage of metal in head, neck and base is shown by upright figures on each section, except in the two sets of sections (Messrs. Morison's and Wellington's), which make these percentages uniform throughout. The latter have the percentages given on the 100-lb. sections only.

PRELIMINARY DESIGNS BY THE I

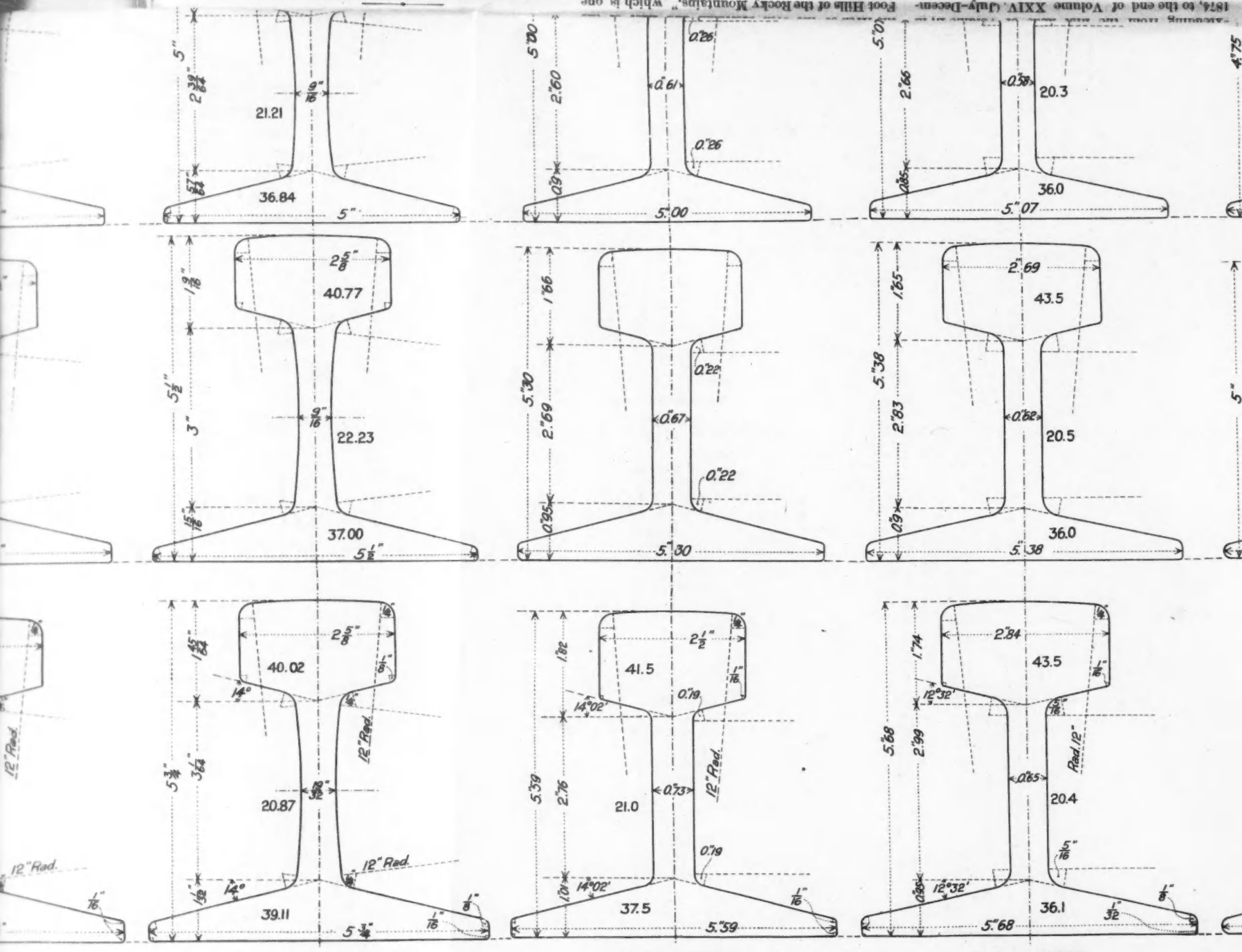
PREPARE



J. D. HAWKS. R. W. HUNT. GEO. S. MORISON.

INDIVIDUAL MEMBERS OF THE AM. SOC. C. E. COMMITTEE ON STANDARD RAIL SECTIONS, SHOWI

ARED UNDER RESOLUTION OF THE COMMITTEE AS AN EXPRESSION OF THE INDIVIDUAL PREFERENCE OF THE SEVERAL MEMBERS R



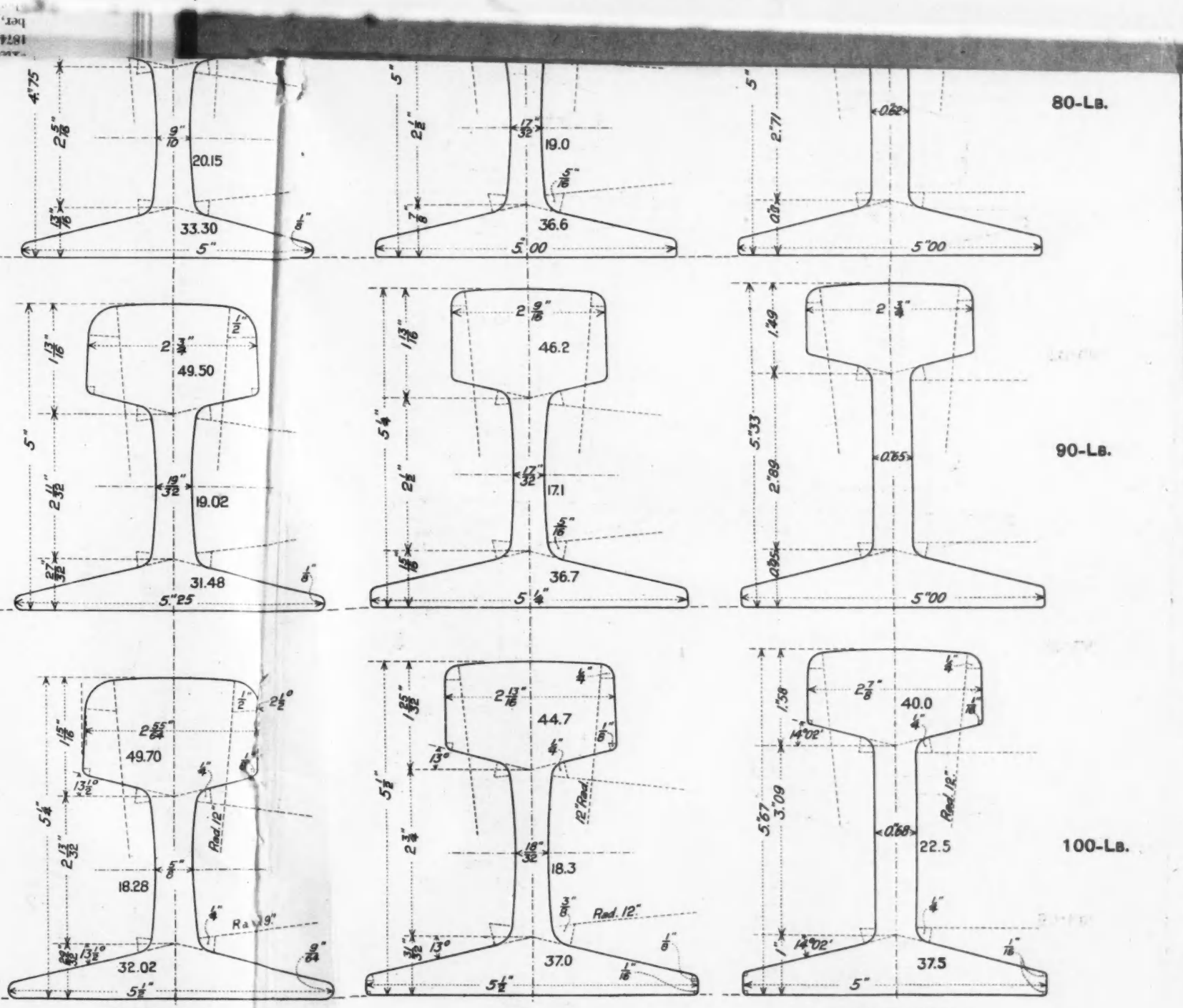
A MUCH heralded series of experiments is now in progress in this city on the important question of

Foot Hills of the Rocky Mountains," which is one of the most complete, in fact, the only report appearing completeness, regarding the number

1874, to the end of Volume XXIV, (July–December, 1890), is now in press, and will be issued

OF THE AM. SOC. C. E. COMMITTEE ON STANDARD RAIL SECTIONS, SHOWING SECTIONS VARYING FRO

HE COMMITTEE AS AN EXPRESSION OF THE INDIVIDUAL PREFERENCE OF THE SEVERAL MEMBERS PRIOR TO ANY DISCUSSION IN COM



FROM 40 LBS. TO 100 LBS. PER YARD.

OMMITTEE.

CHAS. HART & SONS, LITH., 99 VESEY ST., N.Y.

sweeping at night or the patrol system of hand sweeping, will really be most effective in keeping streets clean. The accumulated experience of mankind up to the present date is that either roast beef or roast mutton is very good food when of good quality and well cooked, but that each is viler than the other when of bad quality and ill cooked. But we can easily imagine that all this would count for nothing with the keeper of some third-rate boarding house in search of an explanation why his boarders grew thin; and similarly the whole city of New York seems to have been humbugged into thinking that there is really some occult mystery to be solved as to the best way of cleaning streets as a necessary preliminary to actually cleaning them. As we write, the record of no less than *two days'* actual experience (tabulated in another column) is available, and on the strength of it the New York *Times* declares in a solemn way, without a single wink, that "the result of the comparison between the patrol system of hand sweeping in the day time and the plan of machine sweeping at night *leaves no doubt* of the superior efficiency and great expense of the former," and so on for nearly a column of profound discussion over no less than $500 worth of actual street cleaning work. Results obtained by the expenditures of millions under each system in the various cities of the world are already of record if any one chooses to look into them; but by a little judicious "humbuggery" all this is made to go for nothing with the sapient public which the politicians understand so well. Its eagle eye is now fixed on these weighty "experiments." They are to continue for a whole month, which is just long enough to ensure that the dear public will have forgotten all about them before they end; and then, hereafter as heretofore, that system of street cleaning will be used which consists of plenty of berths for the lame and the lazy and fat pickings for the wire-pullers, and the streets will still go uncleaned, whatever nominal "system" they may choose to adopt.

We are compelled by lack of space to hold over until our next issue the conclusion of our article on "The Bottom Facts of the Brooklyn Bridge Question," for the bottom facts are many, and we do not wish to make more than two bites at even so large and so juicy a cherry as that. On the other hand, we feel it to be a duty to make entirely clear the real nature of the proposed procedures; not that we expect the warning to have immediate effect. Those who have for three years past so determinedly pushed one particular plan which carries the bridge railway to the Brooklyn City Hall are not likely to stop now, when they have at last managed to secure a technical indorsement for their schemes, which heretofore have been under condemnation and yet persisted in. But in addition to laying before our readers an interesting technical problem, we shall make the facts of record where they will be convenient of access when the time comes to contrast them with actual results. In the meantime we take this occasion to dispose of one or two non-technical questions which have arisen out of the discussion of the Brooklyn Bridge question.

Our esteemed contemporary the *Railroad Gazette* led us into an unintentional misstatement last week. We stated that a certain communication from one of the editors of this journal, which we reprinted, would appear in its last issue. The communication attempted to show, with what success can be judged from our last issue, that a certain method, which the *Gazette* declared to be "so simple that anyone could follow it," was, in fact, so absurd that any one ought to see through it. The communication did not so appear, nor even a line of reference to the fact that it had been received and was held over. We are therefore placed in the position of having made a wrong announcement, but the fault is not our own. We were assured on Wednesday that the letter would appear; and on Saturday only, after both that journal and our own were published, did we learn that our contemporary had "concluded that it ought not to appear without some reply, which there was not time to write."

Our contemporary's delicacy strikes us as admirable, but somewhat tardy, and a trifle one sided. It did not hesitate to put in "without some reply" injurious personal attacks, not only on one of the editors of this journal, but on the first Board of Experts, aggravating its offense in the latter case by declaring in effect that it spoke from personal knowledge of the facts, when in reality it knew nothing whatever about them, and made assertions to their injury which were utterly untrue. Its charge against our editor was merely one of bias, to the effect that "prejudice had led him to consider them (the second Board of Experts' recommendations), chiefly from the side of his own scheme, being unable or unwilling to adopt any other view." How much truth there was in this charge was sufficiently shown last week, but we deem it proper to record the actual facts in regard to the untrue charge which our contemporary ventured to make against the first Board of Experts. It says (italics ours):

> In considering the report of the second Board, we are of course, confronted by that of the first Board of Experts, which differs from it in a manner not to be accounted for *by those unacquainted with the fact that the first Board ignored altogether the teachings to be derived from the experience in operating the Bridge which had been acquired by its officers, preferring to attack the questions, presented for their investigation from the outside, as problems requiring for their solution only an ordinary acquaintance with transportation matters.* The new Board seems to us to have acted wisely in consulting with the only persons who have ever had an opportunity to become acquainted in a practical way with the problems peculiar to this bridge only, (*sic*) some of which are of a very grave character.

Now the facts are, that the engineers of the bridge presented, not one, but many plans to the first Board of Experts, six or eight in all (among which was the plan lately recommended by the second Board in all its essential features and all those shown in Mr. Leverich's pamphlet); that they had not one only, but several different hearings before them, and could beyond doubt have had as many more hearings as they chose to ask for; that they presented voluminous written and verbal arguments before the Board in favor of their own plans and in opposition to that subsequently recommended by the Board, which was also before them from the first. The fact is, further, that Mr. Thos. C. Clarke, of the Terminal Committee of the Board of Trustees, was in constant conference with the Board of Experts up to the end of their deliberations, and then volunteered a statement which accompanied the Board's report when sent in, to the effect that he "agreed entirely with the conclusions arrived at by this Board that the circulating system without frogs and switches is the proper one for adoption." [Eng. News, May 19, 1888.] The views of the bridge staff were, therefore, fully and completely presented to the first Board of Experts. But what the first Board did do, and the second Board did not do (if we may judge from their respective actions), was to early discover the maze of absurdities, impossibilities and elements of danger which we have shown to be involved in the plans which the bridge operating staff was urging before them; and thereafter, it is quite possible, they left the bridge engineers severely alone, not in contempt of their office, but in contempt of the absurdities which they were advocating. The second Board of Experts would be in a pleasanter position than they are now had they been equally fair and equally wise.

Mr. O. Chanute calls our attention to the fact that the inconsistency in horse power alluded to on page 109 in our issue of Jan. 31 arises from using co-efficients of v in meters per second, with speeds stated in kilometers per hour. The fact escaped our attention.

Progress Toward Standard Rail Sections.

The large inset sheet which accompanies this issue will be generally admitted to mark a decided and great advance toward that much to be desired end, general agreement on some standard set of rail sections and an abolition of the present senseless diversity. The sheet shows that a remarkably close degree of agreement exists as to the proper form of rail sections among the thirteen members of the Am. Soc. C. E. Committee on Standard Rail Sections. Considering the circumstances under which it was prepared in advance of all discussion or comparison of views in committee, the agreement could hardly have been closer.

It will be remembered that there was formerly an Am. Soc. C. E. committee of 7 on the "Proper Relation to Each Other of the Sections of Railway Wheels and Rails," which made certain recommendations as to the forms of the heads of rails, and added further, that from the degree of agreement shown in the responses obtained, it appeared probable that proper effort in the same direction would secure substantial agreement on a complete set of standard sections.* In pursuance of this suggestion a new committee of 13 was appointed, of which 6 had been members of the old committee and 7 were new appointments. A glance at the list of members will at once show that, with the exception of one or two unworthy members, the committee was to all appearance carefully selected from among those most likely to proceed intelligently and cautiously with their task.

As the very first step in the deliberations, or rather, as a preliminary to all deliberations, it was resolved that each member of the committee should prepare independently a set or scheme for sections embodying his own personal views of what such a set of standard sections should be, regardless of all prior suggestions and recommendations. The result is before our readers. Eleven different members prepared 10 different sets of sections, and of these all but one set are so nearly in agreement that they approach closely to identity.

By a singular coincidence the one set of sections which differs markedly from the rest and from the recommendations of the prior committee as to the form of the head is a set sent in jointly by two of the former members of the first committee. This set, the one sent in by Messrs. H. Stanley Goodwin and Samuel Rea, differs from all the rest in using a $\frac{1}{4}$ in. instead of $\frac{1}{2}$ in. corner radius, and a slightly flaring instead of vertical side; in having a very heavy head and light neck and base, and in some other less important details. The sections bear a marked general resemblance to the so-called latest revised form of the Sayre section. Mr. Robert H. Sayre, Vice-President of the Lehigh Valley Railroad, devised in 1882 a section which was made the standard of that road and was illustrated in our issue of Feb. 26, 1887. It had an immensely massive head, and a very thin neck and light base, not less than 55 per cent. of the metal being in the head. The sides had an outward flare of 9° and a $\frac{1}{4}$-in. corner radius, the two latter being adopted with the expressed purpose of enabling the side of the rail

*For the Preliminary Report of the committee see in Engineering News, Nov. 3-10, 1888, and Trans. Am. Soc. C. E., Vol. xix., p. 1. For the Final Report see Engineering News, July 6-13, 1889, and Trans. Am. Soc. C. E., Vol. xxi., p. 22.

"to fit the flange." As such it was at least consistent, but the latest revision, which is substantially identical with the 80-lb. GOODWIN-REA section shown in the accompanying sheet, is not consistent with either theory. It decreases the flare by one-half and sharpens the corner radius to ½-in., thus by implication abandoning the theory on which the rail was originally designed, while at the same time it stops far short of the ½-in. corner radius and vertical sides recommended by the former Am. Soc. C. E. Committee.

There are reasons which we will not now attempt to summarize why this single exception should have occurred, and which encourage us to hope that it will be only a temporary exception. It appears plain upon the face of things that it either has a good effect or a bad effect to have the rail accurately fit the flange. If it has a good effect then the original Sayre head should be adhered to. If it has a bad effect, so that the day when wear will bring about a fit should be postponed as long as possible then the ½ in. corner radius and vertical side is presumptively preferable.

The only remaining difference of design in the sections, of any significance, is the distinctive feature in the sections submitted by Mr. MORISON, which is, to make the head of sections of all weight between the limits of 50 and 100 lbs. per yd., inclusive, of the same width, 2½ ins. There are undoubtedly good reasons why such uniformity in width of head would be desirable did it not so injuriously affect the form of sections, but a mere glance at the sections will show the effect in the latter respect to be injurious, and the gain from a uniform width of head is so much less in comparison, if we understand the question rightly, that we apprehend this exception also will prove but temporary.

If so, there will then be nothing left but trivial differences in minor details to impede a unanimous report from the committee. But before even an attempt at agreement on a final report is made the committee will doubtless attempt to secure from at least a majority of the railway mileage of the United States an assurance that the sections will be used if recommended, as also an agreement from the rolling mills to furnish the sections to all customers free of charge for rolls; nor is it likely that the committee will even attempt to formulate its final report until the engineers and railway officials of the country have been pretty generally consulted by circular and have indicated a pretty nearly unanimous agreement upon any proposed standards. At least, there would seem to us to be so much probability of obtaining these agreements by asking for them, and it would be so plainly desirable to obtain them, that we cannot but believe the effort will be made.

Certainly it would be worse than useless to recommend any "standard sections" if they were not likely to go into general use, since it would defeat the very object sought, which is to end the senseless and meaningless diversities of sections which now exist, and which sensibly add to the first cost of all rails, while they as certainly decrease the mileage life of many rails.

We perceive no reason why it would be any less absurd to oppose the introduction of standard screw threads or axles on the ground that "the judgment of the engineer in the disposition of material" should not be interfered with, than it is to oppose the introduction of standard rail sections for the same reason. Where there are constant variations of conditions calling for variations of practice in each case, as in designing foundations, or bridges, or culverts, or track, an attempt to introduce standards would be plainly absurd. We cannot have standard materials or dimensions for ties or ballast, because it all depends on circumstances as to what is economical. We cannot have standard bridges, and, still less, standard foundation or pier plans, for like reasons.

But we might and should have standard bridge floors, because as to them the conditions to be met are always the same, and the most perfect form of protection is not so expensive as to be beyond the reach of even the poorest roads. Similarly, and even more decidedly, there is no single argument of real moment for any variation in the section of any one given weight of rail. Poor roads or roads of light traffic will naturally use lighter rails than rich roads of heavy traffic; but if a road is going to lay down an 80 lb. rail, there is no possible reason why the section which is best in Ohio should not be best in New Jersey or California, nor why the section which wore best under one train an hour should not also wear best under one train a minute, nor why the section which is best on rock ballast should not also be best on earth ballast or even no ballast at all; nor why "every one should not be wiser than any one" in deciding what the best 80-lb. section really was. We are aware that certain fine-spun theories have been put out, to the effect that it was desirable to have two or three different standard sections for each weight of rail, but such theories have met little acceptance, and after having carefully examined them they appear to us to be based on an imperfect investigation of the question.

That the majority of engineers take this view of the matter, and are also pretty well agreed as to what the details of standard sections should be, is strongly indicated by the sheet of sections which appears with this issue. It constitutes a sufficient answer, and the only one we have ever thought it worth the trouble to make, to the labored attempts of one of the railway journals of this city to show that "the time had not yet come" for standard rail sections. The real situation in regard to them will be clearer now than it was before, even to our contemporary, as well as the degree of sagacity which it showed in reading the facts of the existing situation.

The Latest Aerial Humbug.

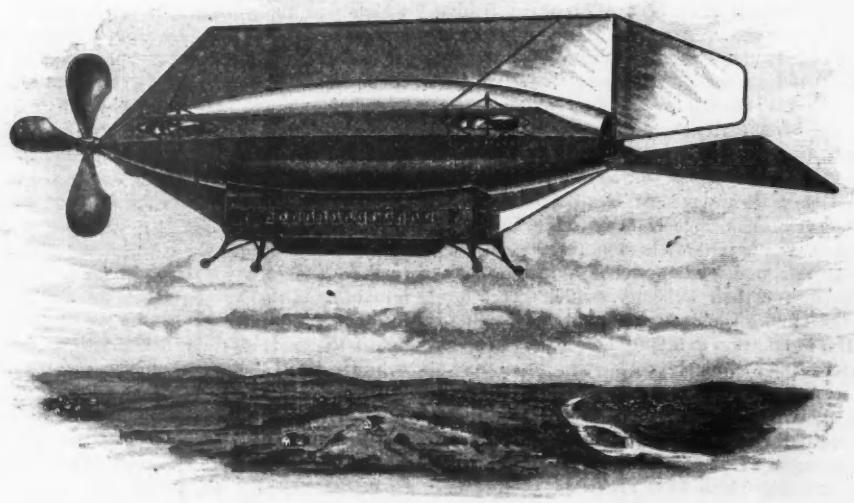
We should regret to even appear to throw cold water upon any honest attempt to solve the problem of flying; but if a plain statement of facts does so it is not our fault, and a plain statement of the facts in regard to the latest attempt at floating an air machine—and $20,000,000 of stock—will at once have interest for the scientific world, and possible value as a caution to credulous investors.

We have before us a flaming address "To the People of the United States," declaring in large capitals that "THE AIR-SHIP FLOATS" which is now being exhibited every 15 minutes in the Chicago Exposition Building (admission 25 cents), and describing the nature and lesson of this floating in exultant words, of which the following will serve as a specimen:

> Upon witnessing the test we are amazed at the simple appearance of the craft; and watching her natural, easy movement in space, the unscientific mind is hardly prepared for the statement that the combined mechanical genius of the past was unable to produce this result. Men of science in various departments having confidently asserted that "The thing could not be done," that the propeller would not propel, that the rudder would not steer, that the motor would not be sufficient, and other and numerous objections, now gaze in silent awe of the graceful little wonder as she silently glides at the will of her great inventor.
>
> Yes, the Air-ship is a success in spite of cynics and ignorant critics. Facts have been demonstrated the probabilities of which were loudly and confidently denied by those who thought they knew what they asserted.

We have also before us what ordinarily gives little information, but in this case is full of instruction, viz: a blank letter-head of the "Mt. Carmel Aerial Navigation Co., Mt. Carmel, Ill." About a third of the sheet is needed to indicate lithographically the glories of this company. In the right hand corner is the modest statement, "*Subscribed* capital, $20,000,000.00." We call particular attention to the ".00," as telling a plain tale with unusual brevity. Beneath it is a reduced picture of the air-ship itself, which we show below. At the other side is a picture of a gigantic factory, covering some six or eight acres, the foundation stones for which, so far as we can learn, are not yet laid. Beneath this again is a list of six cities in England and America where the company has "offices," not one of which is yet open, unless it may be the two in Illinois. A list of six of the principal officers of the company completes the showing.

Not thus are the great advances in science usually heralded. Not thus does the true inventor usually blazen forth what he is going to do before he does it. On the contrary, he is usually modest and silent. The circumstances seem strongly to indicate that some wild enthusiast, who knows little of what has been done before him, or some scheming speculator, has hold of the enterprise. Nevertheless,



THE CHICAGO AIR-SHIP.

bona fide inventors before now have been wildly enthusiastic, and yet finally successful; and there are even some instances where such premature flourishing of trumpets has heralded a successful enterprise. Some allowances may well be made for the intoxicating effect of the ozone which blows over the boundless prairies of the West, and everyone must feel a natural curiosity to know how

much or how little of actual achievement lies at the bottom of so much free newspaper advertising. Through the kindness of an eminent engineer, who has critically investigated all that has been achieved so far, we are enabled to gratify this natural curiosity.

The facts are these :.

The working model of the "Pennington Air-Ship," now on exhibition as stated, differs from the earlier descriptions of the proposed air-ship, as given out by its inventors, in several important particulars. It is not made of aluminum, it does not lift its motive power, and the speed is very slow. The model is a varnished silk balloon, clumsily like a whale, about 24 ft. long. Including the rudder it is said to be 30 ft. long and 6½ ft. in diameter. It has side wings or vanes of silk, but these do not sustain equilibrium propellers as shown in the picture. A vertical keel cloth and rudder are stretched above the balloon, and another cloth inclosure below representing the peculiar-looking car shown in the view. Both of these parts are of white cotton goods, roughly fitted, and mismatch the varnished silk of the balloon, which latter looks as if well made. Before the model was exposed to the public it was said that the upper keel cloth, rudder and car were of aluminum, but they either proved too heavy or failed to materialize.

At the front of the balloon, and connected with it by a light wooden framework, is placed a two-bladed propeller, about 6 ft. in diameter. It is made of cloth, stretched upon a light frame, and is driven by a light endless string, which runs from the propeller to the cloth inclosure representing the car. The latter presumably contains a light dynamo and the power is conveyed thereto by a flexible wire some 50 ft. long, extending from the car to some storage batteries placed within an inclosure in the middle of the Exposition building. This inclosure, which is about 40 ft. square and 8 ft. high, screens the balloon from prying investigation when it comes down.

Every 15 minutes or so the machine gently rises from the inclosure to a height of about 40 ft., and the propeller being put in motion flies around in a circle of about 60 ft. in diameter, either to the right or to the left as the rudder may be set, being kept from straying out of the circular course by the connecting wire, which on its way from the dynamo to the storage battery, is attached to the top of a staff, standing about 10 ft. above the floor, and furnishing the pivot or center for the circular movement.

After flying around for a few minutes, the machine is gently hauled down within the inclosure, and the loss of hydrogen gas made good, if so required, from a portable generator. It was first said that this model air ship was to carry a passenger, possibly two, but the lifting power evidently amounts to but a few ounces, and the balloon is pulled down between finger and thumb. The propelier makes about 60 revs. per minute, and the speed of the apparatus is from 3 to 3½ ft. per second, say 2 to 2.4 miles per hour.

This seems slow indeed, when it is remembered that the French war balloon "La France" has been driven 14 miles per hour, and that in 1881 M. TISSANDIER showed at the Electrical Exposition at Paris a model electrical balloon 11½ ft. long and 4¼ ft. in diameter, which lifted its own motive power and traveled at the rate of 4½ to 6 miles per hour, with a maximum development of power of 434 ft.-lbs. per minute, all as described in our issue of Jan. 31, 1891.

How utterly insignificant the Pennington performance is, in comparison, will appear from a brief calculation : The cross section of the mid area of the balloon is 33.18 sq. ft., and at 2.40 miles per hour the air resistance is 0.029 lbe. per sq. ft.

For a flat surface, therefore, the resistance would be $R = 33.18 \times 0.029 = 0.95$ lbs., so that a weight of less than 1 lb. at the end of a string would produce the speed in that case. But the resistance is only about one-fifth of this, in consequence of the pointed shape of the balloon, and as the speed is 210 ft. per minute, we have for the power, $P = \frac{0.95 \times 210}{5} = 39.90$ ft. lbs. per minute.

This is less than one-tenth of the Tissandier performance, and only about one-seventh of the power exerted by a 1-lb. pigeon in horizontal flight, which is usually computed at 270 ft.-lbs. per minute.

The inventor claims that the air ship proper will be driven at 200 miles an hour by a gas engine of 100 HP., weighing only 250 lbs. To those acquainted with modern gas engine practice, in which the weights run from 300 to 1,000 lbs. per HP., and who understand the fixed limits of possible pressures, which are less than with the steam engine, this statement of the inventor becomes transparently absurd ; but even if it were true, the resulting speed would not be over 33.12 miles per hour, as we may determine as follows : The diameter being 28 ft., the area of the mid section is 615.75 sq. ft., and the pressure is $.005\ V^2$ in miles per hour, while the coefficient for the elongated shape may be taken as 5, as before. The resistance will therefore be $R = \frac{615.75 \times .005.\ V^2}{5}$.

The horse power required will be equal to the resistance multiplied by $\frac{V}{375}$ (V being as before in miles per hour); and inasmuch as a 100-HP. engine acting through an air propeller cannot possibly give out more than 60 per cent. effective power, in consequence of internal resistances of engine and slip of screw, we shall have the equation:

$$\frac{615.75 \times .005\ V^3}{5 \times 375} = 60 \text{ HP.}$$

whence $V = \sqrt{\frac{22500}{.61575}} = 33.12$ miles per hour.

In point of fact there is no probability that Mr. PENNINGTON can attain anything like this speed, should he build the air ship proper, as proposed, and his present performance exhibits no advance upon previous practice, to say the least of it.

We are disposed to believe, and it would be ungenerous not to assume, that the designers of this latest air ship are merely honest enthusiasts with a bee in their bonnet, ignorant and careless of what has been heretofore achieved, but full of the unreasoning enthusiasm of the untrained inventor, and so ready to make all kinds of promises and assertions with more or less good faith. But a mere glance at the form of this much-vaunted air ship reveals at once that its designers are not informed as to what has gone before in their own line. It will be seen that the shape of the balloon chamber is that of a circular spindle, the largest diameter being at its middle with the front and back halves substantially similar. But it is now well established as an axiom of aeronautics that to obtain the minimum of resistance the greatest diameter must be well forward of the center, the front end comparatively blunt and the rear end much tapered. Every known kind of fish or fowl, without exception, has this form, which alone ought to indicate to a careful inventor that it was the most hopeful form to try, even if it had not been determined to be so by actual experiment, as it was long ago.

We should in no case ridicule or decry any honest experiments in this interesting direction if they were merely experiments, however unpromising or ill-judged they might seem to us; but in attempting to boom the thing commercially in the present stage of its development, or even in a much more advanced stage, the projectors expose themselves to just criticism, as guilty of an intentional or unintentional imposition on the public.

CORRESPONDENCE.

The Proposed Nicaragua Canal Guarantee.

ASHLAND, Ky., Feb. 12, 1891.

TO THE EDITOR OF ENGINEERING NEWS :

SIR – After reading the very able article in your issue of 7th inst., respecting the proposed bill providing for a Government guarantee of the principal and interest of $100,000,000 of bonds to be issued by a private company to build the Nicaragua Canal, it seems to be the only thing for the Government to do, if it desires to control the future of such an important enterprise.

While we have every confidence that this great undertaking is in good hands and directed by able engineers, still the question arises: Does the Committee on Foreign Affairs fully realize the stupendous responsibility they are recommending the Government to assume? The Panama Canal was estimated to be built for less than $100,000,000, yet the company spent $300,000,000 and practically accomplished nothing. Where would the French Government be to-day if it had guaranteed the bonds for that disastrous enterprise? What assurance have we that American engineers and contractors are going to do so wonderfully much better at Nicaragua under very similar climatic and topographical difficulties? The experience at the Isthmus must be to a very great extent repeated at Nicaragua. The lives of Americans will not last any longer nor their systems absorb less malaria on this enterprise than did the Frenchman's on theirs, and that means that any strong constitution is liable to break down in that climate in five years at the most. Having spent seven years in tropical America, including the Amazon Valley, Salvador, Guatemala, Costa Rica, and one year on the Panama Canal, I know only too well what coast life anywhere in that country means. Experience as an engineer on the Panama Canal taught me how easy a thing it is for the contingencies to amount to more than the original estimate on such undertakings. The labor question will be as difficult to solve at Nicaragua as it was at Panama. While I do not know the range of prices paid for contract work there at present, engineering friends of many years' experience in Salvador, Guatemala and Costa Rica tell me that they are too low, and that it is merely a question of time when they will have to be raised.

It is not the object of this letter to discourage, for I have every confidence in the ability of Americans to carry the undertaking to a successful issue, but to urge that the experience of the French at Panama may serve as a constant reminder to prevent foolish expenditure and useless administration.

F. A. SNOW.

[There is no real parallel between the Nicaragua and the Panama enterprises. The more important of these differences may be summarized as follows, and as to every one of them it will be seen that the same causes which led all cool-headed engineers to predict the failure of the Panama enterprise from the first (as this journal did at frequent intervals for more than six years before its final collapse), combine to inspire confidence in the future of the Nicaragua enterprise : 1. There were no preliminary "estimates" that the Panama Canal could be built for $100,000,000, or any sum, except those which emanated from the brain of a wildly enthusiastic Frenchman (M. DE LESSEPS) who was not an engineer, and whose head had been turned by his success at Suez, where the problem of construction was child's play in comparison. Not only were no preliminary estimates in the engineering sense ever made, but not even the center line had been run or fixed over considerable distances two years after work had been begun. There never has been to this day a complete detail estimate made of the work necessary to open the canal.

On the other hand, the preliminary surveys and estimates for the Nicaragua Canal are among the most careful and complete ever made for a great engineering work, and so cautiously made were the Chief Engineer's estimates that an independent Board of Engineers, which has since examined them found no reason to raise them materially, raising only the allowance for contingencies; while we have reason to know that responsible contractors now stand ready to take the work at substantially the engineer's prices.

2. The cost of a *permanent* Panama Canal was in its nature indeterminable because (1) the great cut was in shaky, sliding rock and (2) the terrific floods of the Chagres River could only be controlled by a vast artificial reservoir formed by a dam of great height and cost, and of questionable stability, even the location of which, still less its mode of construction, has never yet been fixed. On the other hand, Lake Nicaragua serves as a natural storage and equalizing basin on a vast scale, completely

eliminating all serious difficulties from floods, while actual borings of all the deep cuttings show that the material is solid and will hold a steep slope.

3. The climate of the Isthmus of Panama is known to be extremely sickly, almost deadly. On the other hand, actual experience through an entire rainy season in constructing a railway across the coast flats, the worst part of the route, has shown no worse sickness among 1,000 to 1,500 workmen than the inevitable malarial fevers, which readily yield to medical treatment and caused few or no deaths of otherwise healthy men. On this important, in fact vital, question, we speak from careful independent inquiry.

4. The laboring force at Panama was necessarily very large. At Nicaragua the heavy work is either dredging or rock cutting, for both of which machinery does most of the work. The labor supply of Jamaica alone, we believe, will suffice to furnish the 5,000 to 8,000 men needed on the east coast. On the west coast the native labor supply is sufficient.

These facts satisfy us that the two enterprises by no means involve "similar climatic and topographical differences," but quite dissimilar ones; besides which, we have the still more important difference between good American and bad French management. Therefore, while we predicted from the first the complete failure of the Panama enterprise, as proposing engineering absurdities, we have from the first predicted, and we now predict, the successful completion of the Nicaraguan Canal for substantially the amount now estimated, unless financial difficulties are added to the natural difficulties of construction.—ED. ENG. NEWS.]

A Brand New Brooklyn Bridge Plan.

COLUMBIA COLLEGE, NEW YORK, Feb. 17, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Whether or no it was the bewildering effect of studying Mr. LEVERICH'S ingenious diagrams, or the mental effort of trying to satisfactorily locate a switching engine at two separate localities and moving in opposite directions at one and the same instant, I know not, but I fell asleep, and I dreamed a dream, and the nature of the dream was on this wise. At each end of the Brooklyn Bridge was an immense cylinder revolving upon a horizontal axis. Each cylinder appeared about 20 ft. in diameter and some 40 ft. long, and the manner of their revolution was steady, and about as the speed of men walking.

I saw also a band, as of rubber, extended from the one cylinder even unto the other cylinder upon the top therof, and the same band extended from the farther cylinder to the hither cylinder upon the under side. The band was moving in virtue of the revolutions of the cylinders.

I looked again, and beheld that the band on the top was thronged with the citizens of Brooklyn, all gliding in steadfast manner toward New York. I looked to see what might be their mode of alighting in that great city, and it seemed to me amazing simple. They were dumped upon the wayside, and straightway they all departed upon their several paths. And I awoke, and behold it was but a dream!

This my dream hath troubled me, Mr. Editor, until I am constrained to tell it you, for I feel that therein I have discovered the true solution of the problem that vexeth the hearts of the sister cities. My plan consisteth, in brief, in a "loop system" laid on the edge thereof, or, otherwise, upon a horizontal axis. I would have two loops, the one for him who traveleth from Brooklyn and the other for the one who returneth thereunto.

I herewith leave my device in your hands, confident that the excellence thereof will receive your recognition. To me it seemeth to solve the problem, so that the inhabitants can receive accommodations and that honorable body, the trustees, can avail themselves of one of the advantages of the "loop system" in continuity, without thereby straining their self esteem beyond the elastic limit thereof.

In case you should esteem it wise to divulge my plans to the world, let me adjure you to omit my name, for I am commonly reported a retiring man, and modest withal. Your respectful servant,

AN HYDRAULIC ARCHITECT.

The Barnes-Martin Plan for the Brooklyn Bridge.

NEW YORK, Feb. 17, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Referring to the proposed working of the Barnes-Martin tail-switching plan, as set sorth in Mr. LEVERICH'S diagram in ENGINEERING NEWS of Feb. 14, it is very plain that Mr. LEVERICH'S theory passes two trains on a single track. This may satisfy theoretical engineers but not practical engineers. In practice some of our locomotive engineers have tried to accomplish Mr. LEVERICH'S theoretical engineering feat, but as yet they have never succeeded. To make it plain to the unprofessional mind, Mr. LEVERICH starts two trains on a single track 45 seconds apart at a mile distance from the starting point; he performs some tail-switching evolutions with the leading train over a crossing which requires 60 seconds to perform when he has only 45 seconds headway to do it in. The Barnes-Martin plan can be operated on 75 seconds headway, hence it will be seen that the plan to purchase a good section of Brooklyn for *tail*-switching facilities for the theoretical Barnes-Martin plan will not increase the carrying capacity of the bridge railway to any great extent, however much the length of the Brooklyn tail and the bank account of the tail-switchers may be increased.

O. F. BURTON.

A New Unpatented Type of Elevated Railway.

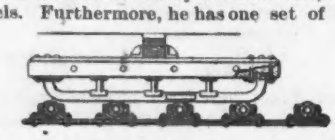
CHICAGO, Feb. 2, 1891.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I see by your columns, and by the daily press, that the subject of rapid transit for your city is the question of the hour. I send herewith a sketch of a new idea—or what I believe to be such—in rapid transit. I may say that I have not applied for any patents, nor have I incorporated a company, though the circular says so. After I had got the drawings and printed the circular, etc., I began to discover that I had not the necessary business qualities to make a success of an entirely novel system of transit. It is therefore submitted to you, not as a business speculation, but simply as a mechanical curiosity, which you may think of sufficient importance to notice. It has received the approval of many first-class engineers, and I have no doubt whatever could, in the hands of the right parties, be made a success. Yours truly,

D. R. GOUDIE.

[Our correspondent, we think, has done wisely in stopping where he did. Certainly he has shown a very usual wisdom and caution. We give a small cut, reproduced from his circular, showing the underlying idea of his device, which is to use small fixed rollers instead of rails on his roadbed, and to provide his car bodies merely with runners, instead of wheels. Furthermore, he has one set of rollers



on top of his roadbed, supporting cars on top of them, and another set of rollers underneath his roadbed, over which runners run, from which car bodies are suspended. In this way he obtains a double-deck railway from a single-deck roadbed.

The general idea is, we are confident, not new, though we cannot refer without search to any precedents, nor do we recall that the scheme has ever had a thorough practical test. We would like to see it tried, though we should hardly expect it to prove a practicable scheme, nor can we perceive why the motion should be any smoother with this kind of running gear than with the ordinary type.—ED. ENG. NEWS.]

Notes and Queries.

Mr. C. B. Percy, U. S. Asst. Eng., Montgomery, Ala. writes: I noticed some time since in your issue of Jan. 22 1887, an account and cuts of a derrick patented by Patrick Kelly, of Poughkeepsie, N. Y. I wrote to him, but have received no reply. Can you give me any information as to who has the patent, or who manufactures the derrick.

C. J. B., Key West, Fla., asks for some preparation that would prevent water and gas pipe from corroding when exposed to salt water seeping through the soil at high tide. Atlantic City and other towns along the New Jersey coast have water and gas pipe laid in sand more or less filled with brackish water. We do not know of any provision beyond first class tar coating being made for their preservation, but would be glad to hear of any other practice.

ANSWERING query of A. McL. H., of Denver, Colo.—I have tested and used the ordinary wrought iron pipe and fittings, butt welded, 1 in. and under to 1,500 lbs. pressure per sq. in.; 1¼ in. to 1,000 lbs. pressure. Lap welded pipe 2 in. to 3 in. to 2,000 lbs. per sq. in. pressure. This is for good pipe. Any defect in welding will give way at any pressure below as above stated. Aluminum steel has been tested in England to nearly twice the tensile strength of ordinary steel. Do not know that rods are on the American market yet. G. D. H.

GARBAGE BURNING.—In issue of Jan. 10, E. A. H. refers our correspondent to the Merz or Vienna system, first used in Vienna, and now in successful operation in New York, Buffalo, Chicago, St. Paul, Denver and Paterson N. J. Two plants are about being built at St. Louis. In this system the garbage is dumped into a closed cylinder filled with superheated steam. The moisture and oil are driven off, the latter being collected. The dried refuse is mixed with phosphate and forms an excellent fertilizer. The patents are owned by the Merz Co., 788 Broadway, New York City, where further information may be obtained.

Foundations.*

(*Concluded from p.* 162.)

Passing now to actual construction, the study of the compressibility of the soil leads naturally to the conclusion that if we would have a structure settle uniformly throughout, we must make all parts of the base proportional in area to the loads coming upon its separate portions. In no other way can we avoid shearing and defacement.

In addition to this, all parts of the footings must be sufficiently strong to transmit the loads upon them to the soil.

The experiments referred to in India showed that in no case should the slope of the footings exceed 45° from the vertical. The safe slope is manifestly a function of the strength and adhesion of the mortar, and of the shearing and transverse strength of the stone or other material used. My own practice has been to make the offsets usually one-half to one-third of the rise of the stone. The adhesion of mortar to stone or smooth pressed brick is less than it is to rough brick; and while in arch and other brick work we are sometimes forced to treat brick masonry as acting in a measure as a beam, depending on the adhesion of the mortar for strength, we would hardly do this in an important foundation. This is done, however, when we approach the 45° limit mentioned.

When it is impracticable to adjust the loads so as to insure a uniform pressure throughout a foundation, we may institute the method of loading every part before building, with considerably more than a maximum load, and long enough to insure exemption from further settlement. Under suitable conditions compression can also be obtained by piling.

Where one part of a foundation rests on incompressible material, and another on that which is compressible, by spreading the foundation over the former so as to reduce the unit of pressure below that which would cause sensible settlement, and loading it preliminary, if the case be important enough, we can obtain good results.

It is the neglect of the precautions pointed out that causes so many unsightly cracks in some of our finest buildings. A case in point is the Cooper Institute in New York, which came to be in a dangerous condition from the transverse rupture of the footing stones, this in turn causing cracks in every direction in the walls above.

One of the largest business structures in New York was founded on a fine running sand, containing considerable water. The foundations under the continuous walls were made very heavy and stood well. The separate piers, however, had each a number of piles under them, which were capped with a ribbed cast-iron plate, on which the pier was built. Through some misunderstanding, these plates were not strong enough to transmit the pressure uniformly to the piles, and before the building was completed dangerous settlement began, caused by the transverse rupture of these plates. The necessary shoring and repairs were very expensive, and traces of the settlement can still be seen in the stone work of the main front.

The architects of Chicago have solved the problem of founding on the compressible soil of that locality in a very interesting way. Mr. JENNEY thinks it desirable in all buildings erected there to limit the pressure to 2 tons per sq. ft. and it has been done in the following manner: The bottom of the excavation is first covered with 12 ins. of concrete. On this is placed a layer of steel railroad bars, spaced 6 ins. to 8 ins. apart, and the spaces filled with concrete. These are crossed with a similar set, and these again by a third and a fourth. In this way a strong foundation is obtained with a thickness of less than 2 ft.

A very interesting case of founding on unsound material is described in a paper by Mr. L. E. CHAMBERLAIN, read at the recent meeting of the American Institute of Architects. About two-thirds of the area on which the City Hall at Kansas City is built was originally a deep ravine, which had been filled in part by cutting down the clay bluffs at the sides and in part by such rubbish of all kinds as comes to a public dump. The fill was fully 50 ft. deep. In this case wells 4 ft. 6 in. in diameter were sunk to the rock below by the use of a large auger operated by steam power. A ⅛-in. iron caisson followed the auger down, and on completion of each hole, solid, well-bonded piers of vitrified brick were built inside. The piers were capped with webbed cast-iron plates, to which steel I-beams were bolted, and the spaces between (also 1 ft. outside and 1 ft. underneath) were filled with concrete. One quarter inch iron plates were then riveted to the top flanges, and on these the walls were started.

*Lecture delivered before the students of the Rensselaer Polytechnic Institute by F. COLLINGWOOD, C. E., and reprinted from *The Polytechnic*.

The piers were so distributed as to bring uniform loads on each. The bricks were found to have a crushing strength of about 135 tons each.

In continuation of this part of the subject we should consider briefly the subject of piling. I have no great confidence in any elaborate formula for the supporting power of piles. All formulæ depend on the penetration at the last blow; but there are so many causes of variation in this that refined calculations are out of the question.

Mr. D. J. WHITTEMORE, past president Am. Soc. C. E., states* that in driving some foundation piles with a Nasmyth steamer hammer he obtained the following results with green Norway pine piles driven into river silt. The third foot of penetration required 5 blows the sixth 29 blows, the ninth 61, the twelfth 153 and the fourteenth 684. The bruised portion of the head was then adzed off, and the next foot required only 275 blows, but this rapidly increased so that the eighteenth foot required 825 blows.

The head was then sawed off, and the nineteenth foot was driven with but 215 blows and the twenty-second foot with 378, or a total of 5,228 blows. Another pile with *no* adzing required 9,923 blows, or nearly twice as many. It is stated in a paper read before the Institution of Civil Engineers † that a Nasmyth hammer delivering 60 blows per minute, will do two and one-half times the effective work in driving a pile, that can be accomplished by the same amount of energy applied through the medium of a slow-moving hand machine.

In deep, tenacious mud it is often found to be easier to pull piles down by applying a heavy load than it is to drive them, and such piles remain unmoved under any load which does not approach too closely to that by which they were forced down.‡ Another great advantage of this method is that they are left in a perfectly sound, unshattered condition.

Piles forced into very soft material giving 1 ft. to 2 ft. penetration at the last blow will still bear heavy loads. An interesting example of this was at the bridge across the Mobile River on the Mobile & Montgomery Railroad, where it was found that such a pile, 60 ft. long, after standing over night would require heavy driving to start it. §

A simple formula, perhaps as good as any, for the bearing power of piles has been proposed, as follows:

$$L = \frac{2\ w\ h}{S + 1}.$$

In this—

L = the safe bearing load in pounds.
w = the weight of hammer in pounds.
h = the fall of hammer in feet.
S = the penetration at last blow in inches.‖

In the transactions of the Institution of Civil Engineers ¶ the skin friction on piles driven in blue clay is given at 1,875 lbs. per sq. ft., and that on a 14-in. iron tube in light earth at only 53 lbs. per sq. ft.

To withdraw a 6-in. iron pipe sunk in sand, I found about 200 lbs. per sq. ft. of the incased area to be required; and this agrees practically with the notes of other writers as to the friction on larger iron cylinders.

As to the use of piles in general, some very pertinent remarks were made by Mr. BERNAYS, M. I. C. E., in a discussion before the Institute of Civil Engineers.* "He had driven many thousand piles in his time, and was bound to say he would never again drive a bearing pile if he could possibly get a good foundation otherwise. . . . Those who had to deal with alluvial soil knew how rapidly the ground varies within a few feet. He had seen a wall where the piles were driven for the foundation most satisfactorily, and where a few feet farther on, apparently in the same soil, the material was so soft that when the backing came against the wall the piles moved forward and brought the wall with them. . . . He wished to say, especially to the younger members, that piles should never be driven, if it could be avoided, where the soil was not of sufficient tenacity to keep them in position. They were like the legs of a chair, well supported at the bottom, but a slight push would send them forward." He also described the split and battered condition often found at the points of piles on uncovering them, and then says: "In many cases the same amount of money spent in excavation, with good appliances for pumping and timbering, would enable the engineer to place a wall on a foundation he could thoroughly rely upon, dispensing with piles altogether."

I have already mentioned the foundations of the New York approach of the East River Bridge built in "the swamp." These were a case in point. Every one told us we could not found except on piles, simply because no person had ever yet done it; but good sheeting and a sufficient pumping power enabled us to excavate to sound and incompressible material, and get an absolutely stable foundation.

Piles or timbers for a foundation, in *any* form, must always be dispensed with in situations which are not permanently wet, as failure is sure to result eventually through decay. In salt water fatal enemies to piles are the limnoria and the toredo. The only sure protection of naked piles against these is the best quality of dead oil creosote injected to at *least* the amount of 12 lbs. per cubic foot of timber. CUSHING'S method, of encasing the piles, either singly or in cluster, in iron cylinders, and filling all vacant spaces in the cylinders with concrete, is also effective. A new pier at Old Point Comfort, recently built, was founded on piles, which were cut off at a uniform depth below the surface of the water, but several feet (I think about 8) above the bottom. Hollow cast iron cylinders were then lowered over these, and all spaces in the cylinders filled to the top with fine concrete. The cylinders reached to a proper height for attaching the wrought-iron beams supporting the planking, suitable brackets being cast on them for that purpose.

We must pass over the use of the water jet in pile and caisson sinking, screw and disk piles, the use of sand columns, etc.

One of the best known methods of founding, where skilled labor is unobtainable, is to sink brick wells 5 to 18 ft. in diameter to 50 ft. in depth and over. The skin friction on these becomes so excessive that loading up to 300 tons is needed sometimes to overcome it. This is found in the alluvium in India to be from 500 to 1,500 lbs. per sq. ft.* At the Dufferin Bridge it was 1,000 lbs. for wells 12½ ft. in diameter.

Other determinations of the important element of skin friction are as follows: the iron caisson of the St. Charles Bridge was sunk through 20 ft. of bowlders and gave 466 lbs. per sq. ft. The wooden caissons of the East River bridge gave approximately 900 lbs. in bowlder, clay and sand, and 400 to 600 lbs. in clear sand. Gen. SOOY SMITH obtained 200 lbs. against an iron caisson at the Waugoshauce lighthouse.†

Passing on, we will consider briefly the old method of founding by cofferdams. It has been laid down as the result of experiment by M. MONTAGNIER that in depths of water of about 17 ft. or over it is most economical to use pneumatic caissons, while at less depths cofferdams are to be preferred.

This can only be determined in any case by a careful estimate. M. MONTAGNIER found that by his caisson cofferdam, using compressed air, he made a saving in price, and also of half the time, by using it in a depth of only 6½ ft. of water. This caisson will be found illustrated in ENGINEERING NEWS of July 30, 1881. It was made of iron-bolted together, and packed at the joints with rubber, and could be removed and used at any number of piers in succession.

Open cofferdams, consisting of double walls filled between with clay, have been successfully used in depths up to about 35 ft. No such work should be undertaken without carefully prepared plans, which take account of all possible contingencies, and which provide abundant material to resist all strains and shocks that can come upon it. It always pays to study out carefully in the office the details of temporary as well as permanent work.

A solid puddle wall 1 ft. thick, if sufficiently supported, will successfully resist the passage of water; the practical difficulty is to prevent subsidence and rupture. A through bolt or any smooth surface invites the passage of water, and the smallest passage, once established, rapidly increases in size. In a valuable lecture by Mr. W. R. KINNIPLE, M. I. C. E., before the Royal Engineers,‡ he describes what he calls "stock ramming" as a means of stopping leaks in cofferdams. It consists in boring a 3¼-in. hole through the sheeting piles, and introducing cylinders of clay slightly smaller and 6 ins. to 9 ins. long. These are forced in by the rammer, which is a stick 3 ins. in diameter and 3¼ ft. long, with head and foot bound with iron, and having a cross bar near the head for convenience in handling. To overcome the difficulty of withdrawing it on account of suction in the clay, a ¾-in. air hole is bored in the center of the foot for 20 ins. to 30 ins. up with a cross hole at top to admit the air. A leather flap across the bottom prevents the clay from stopping the hole. By using heavy mauls in driving the clay in with this, a leak can be stopped under a heavy head.

The next development in methods of founding was the use of water-tight open caissons, which were floated into place and sunk on a previously prepared bed, by building the masonry of a pier or other structure within them. A combination of an open caisson with a pneumatic caisson beneath, within which the excavation was made, was the method used in founding the New York pier of the East River Bridge. The open caisson helped to give stability against overturning, and at the same time gave a means of keeping the load upon the edges and other supports of the caisson within safe limits. The excess of weight above the sustaining power due to the displacement was never allowed to go beyond a fixed amount. The use of floating caissons was first made in 1738, by Mons. LABELYE, in founding the piers of Westminster Bridge, at London.

The use of compressed air as a means of founding was a great step in advance. It is found, practically, that its scope is limited. When the depth reaches 50 ft., the effects of the pressure upon the human system begin to be seriously felt, and the time of work must be shortened At 80 ft. two-hour shifts are as much as should be borne, and even then serious results are sure to follow with some of the men employed. At 70 to 78 ft. depth four hours were made a day's work at the New York tower of the East River Bridge, and the utmost care was taken to keep the men from the risk of sudden change in pressure or over exertion after coming out.

Great economies can be exercised by proper design in pneumatic caissons. For example, to insure the best conditions for the health of the workmen, an excess of air must be supplied beyond that needed to replace the loss by leakage. This excess can be advantageously used in blowing out the debris through pipes, or in hoisting it in properly designed air locks. (An interesting paper on this method was recently read before the Institute of Mining Engineers.) The lighting, it done by candles or lamps, is very expensive and unhealthful, on account of the imperfect combustion and enormous waste. Electricity or fixed lamps supplied with air at ordinary pressure are greatly to be preferred.

Questions of stability against overturning, or irregular descent; of the forces acting and an economical adjustment of materials to resist them; of the safety of workmen and convenience of access and exit; and of convenience in supply of materials for filling the caisson—all have to be considered.

On account of the impracticability of using compressed air under a greater pressure than about 100 ft. of water, and the difficulties accompanying its use in a swift current, bottomless caissons are now used to a very great extent.

The caissons at Coteau Bridge,* just above the rapids of that name in the St. Lawrence River, were of this class. Velocities of water up to 9 miles per hour had there to be resisted, the depth being 24 ft. The gravel had to be excavated by dredging to about 5 ft. below this, and it was not unusual for oak spuds 18 ins. × 20 ins. in size to be snapped off like pipe stems. The caissons were built with 12-in. walls of hemlock, 20 ft. × 66 ft., with pointed ends, and lowered by heavy tackle from two scows, between which they were suspended. Along the inner edge at bottom canvas bagging was nailed, and as soon as the caisson was loaded so as to rest on the bottom, divers were sent down to place bags of concrete along the edge, to hold down the canvas and exclude the current. Concreting was then continued day and night until the caisson was half filled, after which the water was pumped out and masonry begun on the foundation thus formed.

The concrete used in this case was made 6 to 1, that is, 1 part Portland cement, 1 part sand and 5 parts broken stone which would pass through a 2 in. ring. In regard to this, the remarks of Mr. KINNIPLE in the lecture heretofore mentioned are very important. He says there is a loss of strength in discharging freshly mixed concrete under water "which has been determined by numerous experiments as being equal to about one-half of its strength out of water," and that Portland cement concrete should not be leaner than 4 to 1 for such a use. He had "ascertained that concrete in the process of being deposited through water, and with *only* 1 *in.* of quiet water over its surface as deposited, even when mixed as rich as 3 to 1, was most seriously weakened by the separation of the finer particles of cement from the body of the concrete."

A remarkable instance of unsound work resulting from lack of care in depositing concrete under water is illustrated in a report made September 22, 1870; to the Department of Docks of New York. Having myself seen the cloud of cement washed from the open skip then used as it descended through the water, I was not surprised at a later time to learn that the method pursued was condemned.

The method of sinking cellular open caissons was very successfully applied by Mr. MACDONALD at the Poughkeepsie and Hawkesbury bridges; the material being dredged up through well holes, while the pockets were filled with concrete to give weight sufficient to overcome the frictional resistance to settlement.

At Poughkeepsie a depth of 125 ft. below water surface was reached; and at Hawkesbury 148 ft., the total height of the pier being 191 ft. Recent reports from the latter bridge mention a curious and irregular movement of the tops of the piers of about 2¼ ins. up and down stream, but no settlement seems to have occurred.†

Mr. BOLLER introduced a novel method of founding at the Thames River bridge at New London. At this point the water was from 5 ft. to 57 ft. deep, with mud at the bottom 10 ft. to 80 ft deep. For each deep pier a large cellular timber crib was sunk. This had wells, open to the bottom, and a large central space for the pier. By loading the pockets and dredging through the wells, the sinking was continued until the crib had penetrated 20 ft. into the mud. A large number of bearing piles were then driven in the central space and sawed off at the mud surface. The mud was then removed from between the piles and the spaces filled with concrete. A floating caisson was

* Trans. Am. Soc., C. E., Vol. XII., p. 442.
† *Engineering*, London, Vol. 25, p. 142.
‡ ENG. NEWS, Vol. 20, p. 510.
§ ENG. NEWS, Vol. 13, p. 210.
‖ ENG. NEWS, Vol. 20, p. 511.
¶ *Proc.*, Vol. 64, p. 213.
* *Proc.*, Vol. 64, p. 208.

* Proceedings Inst. of Civil Engineers, vol. 35.
† Trans. Am. Soc. C. E., vol. 2, p. 411.
‡ Annales des Ponts et Chausses, 6th series, vol. 1, p. 223.
Eng., London, Oct. 10, 1890.

* ENG. NEWS, April 12, 1890.
† *Engineering*, London, Oct. 10, 1890.

then sunk on the foundation thus prepared by building the pier within it. §

The sinking of the bottomless caisson for the jubilee Hooghly bridge in India was a very interesting piece of work. The caissons were sunk through the silt by the use of boring heads 10 ft. in diameter instead of dredges, which cut to 8 ft. below the edge, and eventually (by extension of areas) to a diameter of 14½ ft. The material was lifted and discharged by the use of Korting's ejectors. One of the caissons, when 60 ft. high, got canted to 7½ ft. from vertical, but was finally righted.

Canting is one of the difficulties attending all caisson work, and was the greatest one met at the Hawkesbury bridge. The great desideratum always is to have a caisson sink slowly and regularly. With the utmost care, however, there *will* be delays, and the surrounding silt and earth becomes compacted against the caisson, so as to largely increase the resistance to movement. Then every bearing surface is cleared and the load increased, when suddenly a movement will occur, which often does not cease until, through some inequality the caisson is canted decidedly from the vertical. In other cases the earth is softer on one side than the other and closes in more quickly against the caisson, causing the greatest pressure to be on the soft side. Or it may be the earth is higher on one side than the other. Whatever the reason, the engineer will find his ingenuity severely taxed at times in trying to preserve verticality and uniformity in the descent of a caisson.

For this reason it is not safe to restrict the horizontal area of a caisson too closely; and it is well to have a surplus of bearing surface, which will come more and more into play as the cutting edge penetrates more deeply into the earth. For example, in the New York caisson of the East River bridge there were at 6 in. penetration about 2,500 sq. ft. of bearing; 3 ins. more depth increased this to 3,150 ft., and a penetration of 2 ft. gave 5,000 sq. ft.

There are many other things I would like to mention which might be of interest to you, but I have already taken quite as much time as is desirable for a single lecture. Let me reiterate the thought with which I began, by saying there is *nothing* with which an engineer has to do which is so sure to eventually expose the slightest carelessness, inattention to details, or dishonesty on his part as the foundations he may build. There are some things in which the rule of "good enough" may pass muster and never be found out; but it is not so with a foundation. A failure in this, is a failure in the whole structure—it may be repaired, but only at great cost, and too often some resulting defacement will remain as a disagreeable and painful reminder of a neglected duty.

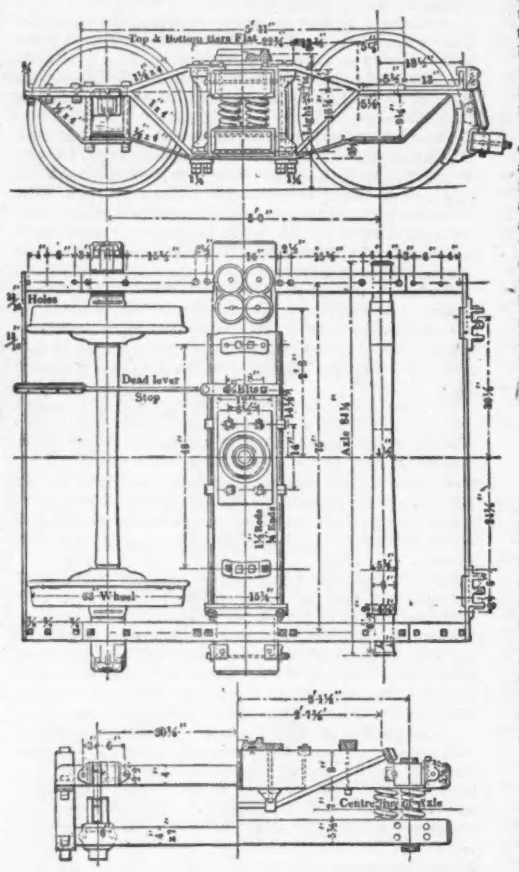
Is there not a parable in all this? Can a young man in the formative years of his life neglect all duty, cultivate everything but the best side of his character, "sow wild oats" as it is ordinarily said, and then expect his after life to show no resulting scars? Such is contrary to all experience. Therefore, as a final word, let me say to you young men, "Look well to your foundations" in *all* things.

Hanging Brake Beams from Truck Frames.

At the meeting of the Southern and Southwestern Railway Club on Jan. 15, Mr. P. LEEDS, Supt. of Motive Power of the Louisville & Nashville R. R., contributed a paper advocating the hanging of outside brake beams from the truck frame rather than from the car body. We reprint the paper as follows:

In considering this subject, let us first take the matter of safety to employees. In 30 years of observation I have never known a hand crushed between the drawheads of cars in coupling; still, from late reports one would think this the greatest danger of coupling, while the facts are, it is *one* of the least. Cases of fingers and hands caught between pin and dead-wood, hands and arms between dead-blocks, etc., or feet caught by the wheel are more numerous; and I have seen several accidents from the brake beam catching and holding the foot and ankle in the best of positions for the wheel to do its work by throwing the person down. Now, some trucks must be built where an inside hung brake is impracticable, and so the only thing we can do in such cases is to make the outside one as safe as possible. My idea is to either so hang it as to enable brakemen and switchmen to step on it and ride when coupling, or to carry the beams so far under the car as to be always out of the way; this last cannot well be done, but the former can be accomplished by using hangers so short as to preclude all danger that they will swing sideways and by placing hand rails on the end of cars, at each of the four corners.

As to safety in running, any of us would hesitate to say that a truck built so rigid that all the wheels were held in the same plane, regardless of whether one of them was supported or not, was as safe as the passenger truck with each wheel free to follow every depression by the vertical play of the box in the pedestal. Then why is it safe to clamp these wheels to a rigid body in such a manner as to make it impossible for the wheels to accommodate themselves to the condition of the track, even on a straight line? This is, in my opinion, poor practice, as the strain thrown on hangers is about the same when the wheel strikes a low joint as though it was a suspension bolt suddenly made to carry the entire load on that wheel, our system of hanging below the center of the wheel making the connection rigid. But the great danger, as my observation apparently teaches, is in going onto a curve or coming off one, with the truck clamped rigidly to the body by the brakes being set. On a straight line, the normal conditions are that each wheel is held equidistant from the body, but on striking a sharp curve with great elevation both the canting of the truck and the position which the body takes (according to speed) brings the truck and body closer together on the outer side than the inner if the brakes are not set, and tends to do so if they are. Under these conditions, the brakes must slip on the wheels (which they can scarcely do), or else, failing to break the hangers, must carry the weight of the inner side of the truck while going around the curve in just so far as the car has a tendency to right itself or assume a perpendicular.



Mode of Hanging Brake-Beams to Truck Frame; Louisville & Nashville R. R.

During several years' close study of the causes of derailment, reported as caused by brake-beams falling down, etc., I have nearly always found the derailment at or near a curve, or found a bad low joint just where the first marks were found. In nine cases out of ten the brake have been hung from the rear body, and the hangers in every case (where I was satisfied the brake was the cause) showed a new fracture or the fastening recently torn out.

As it has been denied that the conditions outlined above ever exist, I would ask any doubter if he ever undertook to let a brake off on a curve that had been applied on a tangent, or vice versa? I have tried it often and found that a brake that I had applied on a curve I could not release when on a straight line, and the reverse I have also found true. I have sometimes to build trucks where the inside hung brake cannot be applied. The accompanying engraving shows how such brakes are now hung; it will be noticed that the additional framework is utilized to derive the benefits of a lipped arch bar.

DISCUSSION.

Mr. E. S. MARSHALL, General Master Mechanic of the St. Louis, Arkansas & Texas Ry., sent the following:

My observation compels me to conclude that the method of hanging brakes exerts a potent influence in the safe running of the trucks. We have a rigid truck as our standard for passenger engine tanks, and for a long time we suffered much annoyance and damage from frequent derailments of the rear truck, the track always being reported in good condition, with no apparent cause for trucks leaving the rail. When personally looking into the matter, I had occasion to ride on one of the engines in question when the rear trucks of tank jumped the track. I noticed a very slight depression in the track, and as the engineer applied the air brake (we were running about 33 miles per hour) I saw the back truck rise from rail. On investigation I found the brakes hung from the frame of the tender, and the brake shoe and beam hung below the center of the wheel, on what we might designate as the bottom quarter. I had the hangers shortened up so that the shoe would strike the wheel at the center, and since then we have had no further trouble.

To better satisfy my mind on the subject, I had a similar hanger hung to the body of a baggage car with a swing motion truck under it, which formerly had the brakes hung from the truck frame. I hung the brakes from car body as an experiment, and found that they produced the same results, viz., the derailment of the rear truck. My conclusions, derived from the results of the tests, are that the brakes should be hung from the truck frame, or else the hangers should not be long enough to bring the shoe below the center of the wheel. I believe that many wrecks, had they been closely investigated, could only have been attributed to the action of brakes hung from the car body.

Secretary MARSHALL: Brake beams suspended from the car body do not bear the proper relation to the wheel at all times. The trucks swivel in going around a curve, and if they are of the swing motion type, there is an additional amount of lateral displacement, all of which must be accounted for in the brake beam hangers. Some roads which have used stirrup-shape hangers fastened at one end with a pin have found that these are bent first one way and then another until finally broken; and they have been compelled to give up this form and return to the old style of hanger, with an eye in either one or both ends. But this form of hanger is objectionable because it allows the brake beam to be entirely displaced if the finger guards are worn away. The inside brake has the advantage of always maintaining a proper relation to the wheels.

Soldering Metals to Glass or Porcelain.

M. CAILLETET has devised a simple method for connecting glass tubes to metal work in the construction of physical apparatus, says *Industries*. The end of the glass tube is first gently warmed, and then covered with a few drops of a solution of neutral platinum chloride and camomile oil. On gently warming the tube to a dull redness the platinum salt is reduced to the metallic state, and a brilliant deposit of the metal is formed on the end of the tube. The tube is then connected to the negative electrode of a battery and immersed in a bath of copper sulphate, when the copper is deposited as a malleable adherent coating on the platinum flux, and thus forms material which can be brazed on to brass or copper in the ordinary way.

Painting Ironwork.

One of the greatest difficulties in the way of protecting iron surfaces by means of paint is the difficulty of producing a firm adhesion between the paint and the metal. When applied to surfaces that have been polished, the difficulty is not so great, though, even in this case, anything that will cause a more perfect adhesion is to be welcomed. It is when paint is applied to the rough surfaces of iron castings, and especially to those that have been scaled by the action of vitriol, that the difficulty of producing a perfect and permanent adhesion is found. In order to secure the best results, iron that has been vitrioled ought to be well washed and carefully dried before the paint is applied. If the articles are small, and will bear the application of a strong heat, they should be heated until oil applied to them smokes. They may then be brushed over with a thin coating of boiled linseed oil; and, when this has become thoroughly dry, they may be painted. When the articles are too large, or when, from other reasons, it is impossible or inconvenient to heat them, the oil may be warmed before it is applied. A thin coat of hot oil will penetrate every pore, displace all adhering dampness, and stick to the metal so closely that no exposure to air or moisture will ever cause it to separate. To such an oiled surface paint adheres well; and when this process is adopted, we never find the paint falling off in large flakes, owing to moisture having crept into some crack and gradually producing a thin layer of rust between the paint and the metal. These remarks, of course, apply to metal that is exposed to the open air, and subjected to the action of frost, moisture and air. It is easy enough to protect metal that is kept within doors, in a dry place, and consequently needs no protection; but iron exposed to the elements is a different affair. And here we may, perhaps, be allowed to remark that these directions in regard to hot oil apply to wood quite as well as they do to metal. A coat of oil applied hot, and allowed to become thoroughly dry, is a powerful preservative, and makes an excellent groundwork for a subsequent coat of paint.—*Engineer and Iron Trades' Advertiser.*

§ ENGINEERING NEWS, vol. 19, p. 390.

Two British Electric Railways.

[FROM AN ENGLISH CORRESPONDENT.]

THE LIVERPOOL ELECTRIC RAILWAY.

It is expected that during the present year the first elevated electric railway in England will be opened at Liverpool. The originator of the enterprise was Mr. M. A. HOLT, Chairman of the Mersey Docks and Harbor Board, who considered an omnibus service much too primitive as a means of public transportation along a dock line seven miles in extent. The Liverpool Overhead Ry. Co. was formed in 1888. The total cost of construction of the road is estimated at £348,700 ($1,681,195). The owners of the land along which the railway is to pass are the Mersey Docks and Harbor Board. They have granted to the company permission to construct and work the line upon very favorable terms. No rent is to be paid to the Board until the profits amount to 6% per annum upon its cost; but when the profits exceed 6%, a yearly rental of £1,000 ($4,850) is to be paid to the Dock Board out of the further profits, and any profit left after the payment of this sum is to be equally divided between the Dock Board and the railway company.

The railway will consist of a double line, for passenger traffic only. It will extend from Fort Road, Seaforth, at the north end of the dock estate, to the Harrington Dock at the south end, a distance of nearly seven miles. It was originally intended to use steam as the motive power; but the rapid progress of electric traction has turned the scale in favor of that system. Construction began at the close of 1889, and about half the line is completed. The line is carried on a wrought iron viaduct. The columns are built of two channels and plates. The viaduct will be covered with a tight floor to prevent anything falling through. Stations will be erected at every half mile along the thickly populated districts, and very low fares will be charged. A traffic of 5,000,000 passengers is expected for the first year. The exact system of electric propulsion to be used has not yet been decided. The chief engineers are Sir DOUGLAS FOX and Mr. J. H. GREATHEAD; the resident engineer is Mr. FRANCIS FOX, who has as assistants Mr. ERNEST WILCOX and Mr. S. B. COTTRELL. The contractor is Mr. W. WILLANS, of Manchester, who was connected with the construction of the City & South London Ry.

THE CENTRAL LONDON RAILWAY.

A bill is now before Parliament, projecting an underground electric railway from the city to Hammersmith, a distance of about 6 miles.

It is intended to construct one iron-lined tunnel for the up and another tunnel for the down traffic, as in the case of the City & South London (electric underground) Ry. One track will be laid in each of the tunnels. The number of stations, including terminals, will be 14.

This new line, which will be known as the Central London Ry., will serve districts between which and the city of London there is an enormous passenger traffic, now carried on wholly by omnibuses.

On the City & South London Ry. a uniform passenger fare of twopence (4 cts.) for any distance has been adopted with fair success. In the Central London Railway Bill, however, first and second class carriages are proposed. It is intended to charge a maximum rate of two pence per mile for passengers conveyed in first-class carriages, and one penny per mile for second-class passengers. Each passenger will be entitled to carry 28 lbs. of personal luggage. For the laboring classes, workmen's trains are proposed, the fares not to exceed one halfpenny per mile, with a minimum fare of one penny.

The Bush Steel Surface Cattle Guard.

The cattle guard illustrated in the accompanying cuts is the most recent addition, and far from the worst one, to an already long list of metallic surface guards. In ENGINEERING NEWS of Aug. 31, 1889, will be found an illustrated description of the National Surface Guard adopted as a standard by the New England Road Masters' Association and now used quite extensively. The Kalamazoo R. R. Velocipede & Car Co. manufactures a guard of woven steel wire, and the Kalamazoo Steel Cattle Guard Co. has placed on the market still another type, approved by the Western Railroad Association and consisting of small steel T-bars bolted to a suitable frame.

The Common Sense Steel Guard, manufactured by the Bush Surface Cattle Guard Co. of Kalamazoo, Mich., resembles the last-mentioned type in that the surface is formed by the webs of small steel T-bars, supported and locked at the ends by a pressed steel arch resting on the ties, as shown in

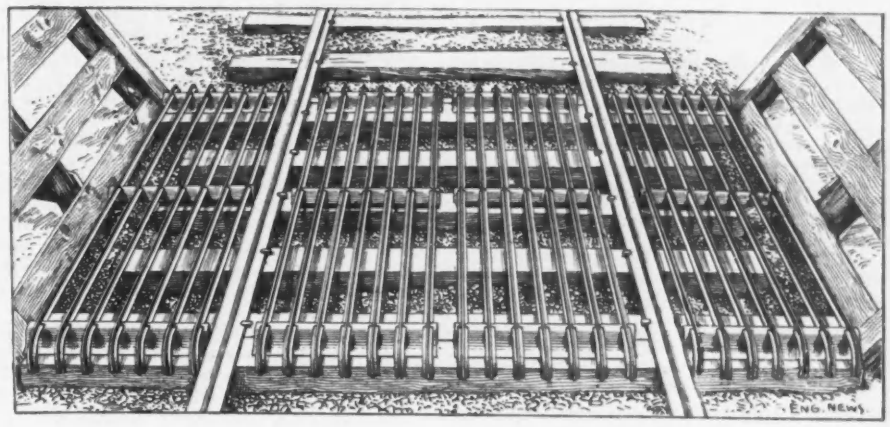


FIG. 1. THE BUSH STEEL SURFACE CATTLE-GUARD.

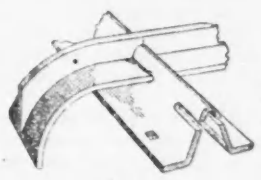


Fig. 2.

the perspective sketch, and locked in the center by a transverse bent steel plate.

It is constructed entirely of steel, and although supported only at the ends has sufficient strength to sustain the weights which will probably come upon it, as tests showed it would support 1,800 lbs. of center load on a single section of 7 bars, with an elastic deflection of only 2½ ins. The guard is furnished in 4 interchangeable sections, 9 ft. long and weighing together 475 lbs. The price on board the cars at Kalamazoo is $20.

This guard is already in use in a number of states, and the makers report that it has proved so satisfactory that third orders have been filled for several railways.

Hand vs. Machine Street Cleaning.

The first report of Mr. WILLIAM ROBBINS, Acting Superintendent of the New York Street Cleaning Department, has been handed to the Mayor, regarding the relative cost of cleaning certain experimental districts by hand and by machine, referred to in our last issue.

As will be remembered, district *A* was to be cleaned by hand in the daytime, and a similar district, *B*, by machines at night. Apparently, taking into account salaries only, the report of Mr. ROBBINS may be tabulated as follows for one day's work:

No. Employees.		DUTIES AND RESULTS.	*Districts.*	
A.	B.		A.	B.
22	24	Drivers collecting ashes and garbage.	$44.00	$48.00
13	19	Drivers collecting street sweepings.	26.00	38.00
31	13	Hand sweepers at 25 cts. per hour.	202.50	32.50
..	20	Extra laborers at $1.50 each.	.....	30.00
..	..	Total cost of one days work.	283.84	168.58
..	..	Total loads of ashes and garbage.	180	178
..	..	Total loads of street sweepings.	65	100

In commenting on the work performed, Mr. ROBBINS says that in District *A* the detail provided one broom man for each 780 ft. of avenues; but the greater quantity of dirt and the poor condition of pavements in certain portions of this district require that not less than 10 broom men should be added to the above given number.

In District *B*, the extra carts (the programme called for 10) were due to the fact that the sweepings are so fluid as to render it impossible to carry more than a half cart load at one time. There were 20 laborers instead of 13 used in cleaning this district, owing to the streets, in places, being blocked with trucks, which permitted the sweeping machine to make only one trip through a street.

As a general result, the report states that District A is better cleaned than *B*; the work of supervision was easier in the daytime, and the work of one sweeper easily compared with that of another, thus fixing responsibility upon a given employee for any negligence. Mr. ROBBINS estimates that a given force working in the day time will do 33⅓% more efficient work than an equal force working on equal number of hours in the night time. He thinks the most satisfactory work could be accomplished by dividing the sweeping machines, attending hand sweepers, and collecting carts into two gangs, and operating them from the East and North Rivers so as to reach the sections where the theatres and public works are located after midnight.

The Annual Meeting of the Institution of Mechanical Engineers.

(FROM OUR LONDON CORRESPONDENT.)

The forty-fourth annual meeting of this society was held on the evenings of Jan. 29 and 30, in the theatre of the Institution of Civil Engineers, the Council of the latter body having extended their usual hospitality to the kindred society. Much of the time of the sessions was taken up in discussing a motion by Mr. MCFARLANE GRAY, by which he proposed to remit all further subscriptions from members who had paid 39 annual subscriptions; the amount of the annual subscription is £3 ($14.55). Judging by the long discussion which ensued, Mr. GRAY had the members of most intelligence on his side, but the motion was defeated by a substantial majority. Some one had said the measure would decrease the income of the Institution—by no means an assured fact, however—and this was enough to turn the scale. Owing to the time spent in the debate on this matter, the report of the Institution's Research Committee on Friction was not read.

The annual report of the Council showed that at the close of 1890 the number of names of all classes on the roll of the Institution was 1,945, as compared with 1,858 names at the end of 1889, showing a net gain of 87. During 1890 there were added to the register 160 names, against which the loss by death was 31, and by resignation 42. The Prince of Wales was among the members enrolled last year. Turning to the accounts we find that the receipts during the year were £6,784 ($32,908); while the expenditure, actual and estimated, was £5,738 ($27,829). This shows a balance of £1,046 ($4,850) to the good. The accumulated capital of the Institution now amounts to £33,708 ($163,483).

Turning to the balance sheet, we find the chief items of expenditure were as follows:

Printing and engraving proceedings, £1,220 ($5,917).

Rent, £700 ($3,395).

Salaries and wages, £1,882 ($9,127).

Meeting expenses, £478 ($2,323).

Research committee, £604 ($2,929).

In spite of the respectable figure put down for rent, £700, the Institution has no home of its own,

with a room or theatre large enough for its meetings. It rents half a dozen rooms on the ground floor of a house in Victoria St. Here is kept a cramped library and a small reading room, which is all the accommodations at the disposal of members. The consequence is that hardly any one, excepting the staff, is ever to be seen at the Institution rooms, and the Council is indebted to the hospitality of the Institution of Civil Engineers for a theatre in which to hold the London meetings. The thirty-three thousand odd pounds which has accumulated over a course of years is therefore jealously guarded by the authorities, who hope before long to make it the nucleus of a fund devoted to the building of a suitable home for the Institution, though naturally this will require a sum much larger than that already saved.

The first paper read at the recent meeting was by Mr. BERNARD DAWSON, of Malvern, on "Some Different Forms of Gas Furnaces." The author described the principal gas furnaces by the aid of wall diagrams, which had been prepared by the draftsman of the Institution, there being a special staff to prepare diagrams without cost to authors of papers.

The greater number of English gas furnaces, in which crude heating gas is burnt, are of the reversing regenerative type. These are used to obtain high temperatures; but there are many situations in which intense heat, such as may be obtained with regenerators, is not necessary, and yet it may be desirable to use gas fuel on account of the increased speed of work, saving in wear of the furnaces, saving in labor, abolition of smoke, or the certainty of obtaining either an oxidizing or reducing flame. In large works, too, it is often a great advantage to be able to concentrate the firing for various departments in one place. The author claimed also a saving of fuel, but he did not bring forward any figures to support this. In a gas producer, however, coal can be used which would not be suitable for ordinary furnaces.

A good deal of the discussion on the paper turned on gas firing for ordinary steam boilers, and some of the speakers appeared to think that for such a purpose an economy over ordinary coal firing could be reached equal to that obtained in metallurgical processes. This is a fallacy, as Professor KENNEDY well pointed out. The great economy in gas firing for, say, steel melting is due to regeneration. A steel furnace without some device for the recovery of waste heat would have an efficiency absolutely low, perhaps not more than 5%; a steam boiler may have an efficiency, without regeneration, of 60 to 80%. Professor KENNEDY himself has made trials in which an efficiency of 85% has been shown. Part of the remaining 15% of the heat was usually employed in creating chimney draught. During the discussion instances were quoted in which regenerators had been applied, on the continent of Europe, to boiler furnaces, and the saving effected had not paid interest on the initial cost, even if it had paid the cost of working. The reason is, of course, on the surface. In metallurgical operations an intense local heat is required; and there is no use for the gases after they have been cooled slightly from their extremely high initial temperature. In a steam boiler the conditions are quite different. An intense local heat is a thing to be avoided, and the extent to which the products of combustion can be cooled down is only limited by the temperature of the steam to be generated and practical convenience in size of boiler. The latter point, of course, prevents anything like an equality being reached between the chimney gases and the water in the boiler; but when one remembers the difference in temperature between a bath of white-hot molten steel—at a temperature which has never been measured—and that of steam at boiler pressures it will be easily understood how little metallurgical operations can be taken as precedents for boiler practice in the matter of gas firing.

A simple feed water heater is the best regenerator for a steam boiler, and even this may be of doubtful advantage in cases where weight and space are limited, supposing always that heating surface and furnace space are properly proportioned. Cases were given, during the discussion, in which a gain in fuel economy of 30 to 35% was obtained in boiler furnaces by the application of regenerative devices. The natural comment on such a statement is "what terribly ill-designed boilers they must have been." Unfortunately there is little reason to doubt the accuracy of these figures or to look on them as very exceptional; and in making this statement the writer's experience by no means prompts him to exclude American boilers.

It is noticeable, however, that gas firing with regeneration is gaining ground in this country in positions in which it has not hitherto been common, and where comparatively low temperatures only are required. Here, of course, reversing generators would be out of place. The furnaces at the Lancashire & Yorkshire Railway Company's works at Horwich, which have been established by Mr. ASPINALL, the Mechanical Engineer of the line, are good examples. These are used for annealing steel castings and heating plates, angle bars, etc., for locomotives.

The author referred to the blow-pipe furnace, in which the heated air required for combustion is delivered through an annular jet surrounding the gas inlet. This gives an intense heat, but the trouble of keeping up the nozzle has generally been an obstacle to its success when handled by ordinary furnace men.

The paper described the Schütze centrifugal sand mixer. In this a revolving table, having nine vertical projecting pins in circles, is revolved at 1,200 revolutions per minute. The sand is projected on to this and is thus thoroughly "combed out." The chief drawback to this machine appears to be the cutting away of the pins, which seem to have been made of wrought iron. The author proposes using hard steel in future; but case hardening would be cheaper, as any slight distortion in shape would be of no consequence.

In the discussion Mr. MAIR-RUMLEY, who has recently made a tour of the United States, referred to American practice in the matter of core making. He stated that American moulders make far longer their cores, without wires, than are thought to be practicable in English foundry practice. He stated that the particles of sand were very much larger and he concluded that a very strong core gum must be used. The writer mentions this fact in the hope that some liberal-minded American foundryman may enlighten the English readers of ENGINEERING NEWS on this subject.

An English Pipe-Joint Cutting Machine.

The purpose of the machine here illustrated for cutting pipe-joints is to reduce waste and substitute machinery for hard labor. We are indebted to the London *Manufacturer and Inventor* for the cuts and the substance of the somewhat meagre description.

The inventor, Mr. F. F. FENNEY, of Stockton-Tees

Fig. 1. Front View.

Fig. 2. Back View.

THE FENNEY PIPE-JOINT CUTTER.

claims that with this machine in place two men in 30 minutes can cut an 18 in. pipe, outside of the trench. The pipe can be cut in the trench by first removing some dirt and the work is performed without strain. The same machine is also usefu for cutting out lead joints for disconnecting water pipes. It thus avoids the usual waste of about one foot of pipe.

In operation the cutting ring can be separated into two halves for application to the pipe. When bolted up in position the cutters are made to pass around the circumference of the pipe by means of the circular rack and pinion device shown. It is said that a machine capable of cutting pipe up to 44 ins. in diameter is in use by the Liverpool corporations.

The New Leveling Survey of France.*

A general leveling of the territory of France was projected and commenced by BOURDALOUE in 1857, but was abandoned in 1864, after the base lines only were completed. The leveling now in progress was commenced in 1884, a sum of $10,000 per annum having been devoted to it each year since that date. This comparatively unimportant amount appears to be devoted to establishing the fundamental lines of leveling. It will be increased as the financial situation permits, when the work will be pushed in all its departments. It comprises (1) a new system of base lines, about 7,500 miles long, following the main lines of railway, whose easy slopes permit very accurate leveling; (2) about 500,000 miles of detail leveling; (3) a series of contour lines.

The new base lines will also serve to connect the French levels with those of neighboring countries, and to compare the mean levels of the Mediterranean, the Atlantic and the English channel.

The entire expense should not exceed $4,000,000. The work is under the direction of Mr. C. LALLEMAND, who has described its progress and methods in a work, "Traité de Nivellement de Haute Précision," recently published.

The base-lines consist of closed polygons, averaging about 380 miles in perimeter. Fixed bench marks are placed 500 to 1,000 yards apart. Each section between two bench-marks is levelled in both directions, and one day's work is confined to each section. All reductions and calculations are made at a central office. The bench-marks are of oxidized iron or bronze, and built into the walls of solid buildings. They enclose a tablet describing their position in the survey and the level.

The level used is carried on a spherical bearing, which permits the telescope to be rapidly placed approximately level without moving the legs. By means of reflecting prisms the two ends of the bubble-glass are visible to an observer standing at the eye-piece of the telescope, so that he can verify the accuracy of his adjustment at any moment without leaving his post.

The rod used is the "compensating rod" of Col. GOULIER, which contains a double metallic rule of iron and brass, by which the variation in length of the graduations on the wooden staff can at any moment be observed. This variation is observed three times a day by the leveler, and amounts to some thousandths per cent., having a daily and also a yearly period, and varying from one staff to another. The divisions are in centimetres, 5 millimetres and 2 millimetres. These divisions are not accurately equal, a systematically erroneous division being preferred, in which the law of error is only known at the central office, as thus it becomes more difficult for the operators to attempt to correct any observations the results of which do not sufficiently agree.

A special and orginal system of bonuses has been applied to this undertaking by M. LALLEMAND, by which the salary earned increases nearly as the square of the work done. Under this system the cost has diminished from $12.70 per mile in 1884 to $10.23, while the salary of rodmen (for instance) has risen from $1.27 to $2.31.

About two-thirds of the base lines are now leveled, and this first part of the work will be finished before three years. The probable error amounts, on the average, to less than ⅞ millimetre for a distance of 1 kilometre (abou 0.057 in. per mile), while in the operations of BOURDALOUE it amounted to from 2 to 3 millimetres per kilometre (0.13 to 0.19 in. per mile). The probable error from Marseilles to Lille does not exceed 2 in. The datum level is the mean sea level at Marseilles, and a new tidal gage has been established there, in order to establish the datum anew with great accuracy.

A NEW SURVEY OF NEW JERSEY has been commenced by State Geologist SMOCK, with the purpose of showing the surface conditions of the State, the nature of the surface soil, forests, mines, etc. This will be a useful addition to the very excellent maps already issued by this State.

* Abstract in Trans. Inst. C. E., from a paper by C. JIMELS, in *Le Génie Civil*, Vol. xvii., 1890.

ELEMENTS OF WEATHER IN THE UNITED STATES, OF MOST INTEREST TO ENGINEERS, FOR THE MONTH OF JANUARY, 1891.
[Furnished to ENGINEERING NEWS by the Chief Signal Officer, U. S. A.]

	STATION.	Temperature. (Deg. Fah.) Average.	Max.	Min.	Range.	Wind. Velocity in miles per hour. Average.	Maximu.	Direction at time of max. velocity.	Precipitation.—Rain and melted snow. Inches. Total.	Heaviest in 24 hours.	Number of rainy days.
NORTHERN CITIES.	Northfield, Vt.	17.6	44	—15	59	8.5	45	SW	3.79	2.00	17
	Portland, Me.	24.0	48	1	47	8.7	50	SE	7.72	2.31	16
	New York City	34.9	60	16	44	12.5	44	S	5.78	1.18	16
	Pittsburg, Pa.	35 0	57	18	39	5.9	28	W	2 43	0 64	17
	Chicago, Ill.	30.2	54	10	44	15.0	54	NE	1.99	1.25	11
	Omaha, Neb.	29.6	56	8	48	7.3	30	NW	2.11	0.95	7
	St. Paul, Minn.	21.2	46	—2	48	6.3	30	NW	1.01	0.42	6
	Duluth, Minn.	20.5	46	—9	55	5.7	25	NW	0.67	0.22	12
	Bismarck, N. Dak.	23.8	50	—9	59	10.2	48	NW	0.05	0.02	3
	Average	26.3	51.2	2.0	49.2	8.9	39	.....	2.83	1.00	12
SOUTHERN CITIES.	Washington City	37.0	60	21	39	7.0	42	NW	6.14	1.58	13
	Louisville, Ky.	39.2	62	24	38	7.4	29	SW	5.21	1.90	12
	St. Louis, Mo.	36.6	59	15	44	10.6	48	SW	1.35	0.76	9
	Savannah, Ga.	50.5	77	30	47	7.6	30	W&S	1.00	0.58	7
	Leavenworth, Kan.	33.2	58	12	46	5.9	30	NW	2.66	1.66	9
	Jacksonville, Fla.	54.3	80	30	50	6.5	40	W	1.19	0.71	6
	Chattanooga, Tenn.	42.0	69	26	43	6.2	30	SW	6.31	1.69	15
	New Orleans, La.	53.2	77	32	45	9.0	35	NW	3.75	1.75	11
	Memphis, Tenn.	42.2	64	28	36	6.9	35	SW	7.33	3.96	13
	Palestine, Tex.	46.1	69	26	43	6.4	26	SE	11.11	4.84	15
	Average	43.4	67.5	24 4	43.1	7.4	34	.....	4 60	1 94	11
WESTERN CITIES	Helena, Mont.	28.0	50	—7	57	6.0	48	SW	0.31	0.15	6
	Port Angeles, Wash.	....	....	....	....	....	....	....	....	....	....
	San Francisco, Cal.	52 2	72	39	33	4.5	28	SW	0.98	0.75	6
	Salt Lake City, Utah	....	....	....	....	....	....	....	....	....	....
	Denver, Col.	25.4	49	—7	56	6.0	26	N	1.60	0.86	6
	Yuma, Ariz.	52.4	76	27	49	7.3	34	N	0.00	0.00	0
	Santa Fé, N. Mex.	22.7	42	—1	43	6.1	28	NE	1.52	0.48	9
	Average	36.1	57.8	10.2	47.6	6.2	33	.....	0.84	0.45	5

THE TUNNEL from Staten Island to Long Island has been authorized by President HARRISON, the bill being signed on Feb. 14. This is the tunnel Mr. ERASTUS WIMAN proposes to construct between New Utrecht and Staten Island. Mr. WIMAN says he proposes to at once organize his company.

THE WEST END RY. POWER PLANT in Boston is now well advanced, and will probably be running within the present year. The boiler house is 160 × 35 ft., with side walls 31 ft. high. The chimney is of brick, 255 ft. high, 27 ft. 8 ins. in diameter at the base, and 17 ft. near the top at the beginning of the outward flare. The flue is 13 ft. in diameter, and is reported to have the largest coal burning capacity in the United States. The engine house when completed will be 300 × 173 ft., with side walls 34 and main gable 64 ft. high. Foundations for 13 engines of 1,000 nominal HP. each are already laid. The boilers will be supplied by Babcock & Wilcox, and the engines by E. P. Allis & Co.

THE FIRST ENGINE used on the Camden & Amboy Ry., says an exchange, is to have a monument to mark the point from which it first started. The point fixed upon by the engineers of the Amboy Division of the Pennsylvania R. R. is near Mile Hollow, one mile from Bordentown, N. J. The first locomotive was built by GEORGE and ROBERT STEVENSON, and arrived in Philadelphia in August, 1831. The only piece of permanent track then laid was three-fourths of a mile long, outside of Bordentown. The locomotive was transferred in wagons to this point and then put together, with a whiskey hogshead on a four-wheeled platform car, for a tender. Steam was first raised on Sept. 15, and the public trial took place on Nov. 12, under Mr. R. L. STEVENS, of Hoboken, as general instructor and manager. The monument will be built of rock taken from the original road bed and will have combined with it some of the rail originally used in the track.

EXAMINATIONS FOR STEAM ENGINEERS are to be held by the Board of Civil Service Examiners for the port of New York, as soon as a sufficient number of applicants report to them. Applications must be made on the printed forms furnished by the examiners. Address Mr. THEODORE BABCOCK, Jr., Secretary of the Board of Civil Service Examiners, New York City, for blanks and further information.

THE NEW YORK AIR BRAKE CO. has its new machine shop at Watertown, N. Y., nearly completed. The total annual capacity of the plant is expected to be from 30,000 to 35,000 sets of car brakes, besides locomotive equipment. All departments are expected to be in running order in about two months.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Philadelphia & Seashore.—It is expected to have this road completed to Sea Isle City, N. J., by June 1. About 25 miles, from Winslow Junction to Tuckahoe N. J., were completed last year.

Western Maryland.—It is reported that this company, which now uses the tracks of the Pennsylvania R. R. into the city of Baltimore, Md., will construct a line of its own into the city. According to the report the road will be an elevated structure over the bed of Jones Falls, a small stream flowing through the city.

Philadelphia & Reading.—The contracts have been let for building the Port Reading R. R. from Bound Brook, N. J., to New York Harbor, 19 miles. There will be a large amount of bridging on the line. The contractors are: Nolan & Bros., Reading, Pa., and J. McBean, 907 Opera House Block, Chicago.

New York Central & Hudson River.—It is stated that the route of the Mohawk & St. Lawrence R. R. has been decided upon. The road will run from Rome, N. Y., along the Black River Canal, via Northwestern, Hawkinsville, Lyons Falls and Lowville to Carthage, N. Y. From Carthage one branch will run to Gouverneur and another to Clayton. The total length of the road will be about 170 miles and its estimated cost is $6,000,000. Work on construction will begin at Rome soon.

Deerfield River.—This company has promised to extend its road from Reedsboro, Vt., to Wilmington, Vt., providing the town of Whitingham will subscribe $10,000 and the town of Wilmington $35,000 in its aid. It is thought that the amount will be raised.

Projects and Surveys.

Columbia, Lima & Benton.—Surveys are being made for a railway by this name. M. H. Cook, Detroit, Mich., engineer in charge.

Springfield & South Charleston.—Surveys are in progress for a railway from Springfield to South Charleston, O.

Pittsburg & Moon River.—Chartered in Pennsylvania to build a railway from Groveton Station, Allegheny Co., Pa., to Remington, Pa. N. T. Sandford, Mansfield, Pa., President.

Little Falls & Dolgeville.—It is announced that a railway will be built from Little Falls to Dolgeville, N. Y., 10 miles, during the coming summer. About $75,000 have been subscribed by the towns connected. Alfred Dolge, of Dolgeville, N. Y., is at the head of the enterprise.

Concord & Rochester.—A bill will be introduced into the New Hampshire Legislature to charter a railway company to build a line from Concord, N. H., via London, Chichester, Pittsfield, Barnstead and Strafford to Rochester, N. H., a distance of about 80 miles.

Bangor & Aroostook.—This company has been organized in Maine to build a line of railway from Brownville, Me., on the Bangor & Piscataquis R. R. via Patten to Prisque Isle, Me., with a branch from Dyer Brook to Ashland, Me. A. A. Burleigh, Houlton, Me., is at the head of the enterprise.

Genesco.—The movement which has been on foot for some time to build a railway from Genesco, N. Y., to York, N. Y., seems likely to be carried through. It is now proposed to build a branch from the recently surveyed line of the Retsof Salt Co., at Piffard, to Genesco, 2 miles. Surveys will be made at once.

Buffalo Dock & Connecting.—This company, which was chartered about 1 year ago, will construct a railway, 7 miles long, along the protection wall between the Niagara River and the Erie Canal at Buffalo, N. Y. The work includes the repairing of the wall, and will be very expensive. E. Van Etten, Buffalo, N. Y., Secretary.

Baraga & Watersweet.—A railway company by this name has been chartered in Michigan. Capital stock, $1,000,000.

Stoneham & Middlesex Falls.—F. W. Spencer, of Stoneham, Mass., writes that this road is to run from Stoneham to Fills Station, in the town of Melrose, a distance of about 3 miles. The surveys and profiles have been completed, and the results are now in the hands of the Boston & Maine R. R. Co., which, it is hoped, will build the line.

SOUTHERN.—Existing Roads.

Roanoke & Southern.—The last section of this road between the North Carolina State line and Roanoke, Va., has been put under contract. Work will begin at once.

Chesapeake & Ohio.—This company has let contracts for the construction of a line from Covington, Va., to Hot Springs, Va., 24 miles. Work is to begin at once and the line completed by June 1, 1891.

Macon & Atlantic.—Tracklaying has been commenced at Benton, Ga., and will be rapidly pushed. It is expected to have 25 miles laid this month.

Fort Payne & Eastern.—A meeting of the stockholders will be held Feb. 24 to elect directors and officers. It is stated that work will commence immediately afterwards on the extension to Rome, Ga.

St. Cloud Sugar Belt.—J. O. Fries, of Orlando, Fla., is in charge of the surveys for the extension of this road from Orlando to Narcossee, Fla.

Covington & Macon.—This railway, running from Macon to Athens, Ga., 107 miles, has been leased to the Richmond & Danville R. R. Co.

Seaboard & Roanoke.—The Macon & Northeastern R. R. Co. has been organized to build a railway from Macon, Ga., northeast to Elberton, Ga., on the Georgia, Carolina & Northern R. R., a distance of about 100 miles. This action, it is stated, was caused by the failure to secure the lease of the Covington & Macon R. R.

Norfolk & Western.—It is stated that the work of extending the Shenandoah Valley R. R. from Front Royal, Va., to Washington, D. C., will commence next month.

Virginia Midland.—It has been decided to double-track the section between Alexandria and Orange, Va., 79 miles. Work will begin in the spring.

Chattanooga, Rome & Columbus.—It is rumored that this company will build a branch to Tallapoosa, Ga.

Paducah, Tennessee & Alabama.—The *Birmingham News* contains the following:

Bonds for the building of the Paducah, Tennessee & Alabama R. R. from Paris, Tenn., to Sheffield, Ala., have been placed and preparations are now being made to push the road through as rapidly as possible. The road is practically finished from Paducah, Ky., to Paris, Tenn., a distance of about 100 miles. The survey has been made from Paris, Tenn., to Sheffield, Ala., a distance of about 150 miles, and this will now be put under contract. The ultimate destination of the road is Birmingham. After it is finished from Paducah to Sheffield, it will be built from Sheffield direct to Birmingham, over 100 miles, penetrating a section of country rich in minerals. It is stated that the Paducah, Tennessee & Alabama R. R. is backed up by the Illinois Central. This R. R. has long been scheming for an entrance into Birmingham and the mineral regions of Alabama. It is now quietly but surely building a line in this direction. There is ample capital behind the enterprise, and it will be pushed through as rapidly as possible. The bonds were easily placed, three parties in the North taking the entire lot.

Carolina, Knoxville & Western.—James I. Williams, of Greenville, S. C., writes as follows:

The Carolina, Knoxville & Western R. R. Co. was chartered to build a railway from Augusta, Ga., via Greenville, S. C., Waynesville, N. C., and Seiverville, Tenn., to Knoxville, Tenn., a distance of about 208 miles. Of this amount 150 miles are in South Carolina, 50 miles in North Carolina and 68 miles in Tennessee. It is possible that the above route will be changed in North Carolina to pass through the city of Asheville. There will be bridges at Augusta and Knoxville and one tunnel. About 14 miles of track have been laid from Greenville, S. C., north, and the greater part of the line from Augusta to Greenville has been graded.

South Bound.—Geo. D. Wadley, Savannah, Ga., Chief Engineer, writes as follows:

About 1,000 men are now at work on the line between the Savannah River and Columbia, S. C. About 45 miles of the grade have been completed and 12 miles of track were laid last year. It is expected to have 75 miles completed by June 1, and the remainder of the line by Sept. 30. There will be bridges over the Savannah and Oconee rivers, 500 ft. and 750 ft. long, respectively.

Projects and Surveys.

Chattanooga, Kentucky & Chicago.—This company will be chartered to build a railway from Chattanooga, Tenn., to the northern line of Macon Co., Tenn., with such branches as may be required.

Augusta & West Florida.—Work will begin on the survey of this line between Augusta, Ga., and Thomasville, Ga.

Lookout Mountain.—Wm. Kinefick, of St. Louis, Mo., and associates will, it is stated, build an incline railway up Lookout Mountain.

Harriman Coal and Iron.—Surveys are in progress for this road under the direction of Hood Tucker, Harriman, Tenn.

North Carolina.—Bills have been introduced into the North Carolina State Legislature incorporating the following railway companies: Carolina & Virginia, Madison to Raleigh & Augusta R. R.—Durham Belt.—Atlantic & North Carolina; amendment—Piedmont Springs—Brunswick, Western & Wilmington.—Danville, Granite City & Western Short Cut.

NORTHWEST.—Existing Roads.

Northern Pacific.—Work will soon be commenced on the line of the Duluth, Pierre & Black Hills R. R. between Pierre and Faulkton, S. Dak. The line runs from Oaks, N. Dak., to Pierre, S. Dak., 181 miles, and it is expected to be in operation by next fall.

Duluth & Winnipeg.—The action of the directors providing for the extension of this road from Cloquet to Duluth, Minn., has been ratified by the stockholders. It is announced that all of the bonds of the company have been floated in England, and that the proceeds will be used in building this extension and also the line from the Mississippi River north.

Chicago, Milwaukee & St Paul.—The preliminary survey has been completed for the line from Chippewa Falls, Wis., to Duluth, Minn., 168 miles. A very favorable route is stated to have been secured.

Mason City & Ft. Dodge.—It is announced that this company will commence surveys for an extension from Ft. Dodge to Council Bluffs, Ia., at once.

Wadena & Park Rapids.—Foley Bros. & Guthrie, of St. Paul, Minn., have the contract for building this road from Eagle Bend to Park Rapids, Minn., 55 miles. About 30 miles of the grading have been finished.

Projects and Surveys.

Duluth, Mesabic & Northern.—The Lake Superior & Northwestern R. R. has changed its name to the Duluth, Mesabic & Northern, and has been incorporated with a capital stock of $5,000,000. The road is to begin at some point on Lake Superior, St. Louis Bay or river, and run to the northern boundary line of the state at some point to be determined upon later.

Chicago, Burlington & Quincy.—A dispatch from Alton, Ill., says:

It has been definitely announced that the Chicago, Burlington & Quincy road will build a steel bridge across the Mississippi River at Alton. A large corps of civil engineers has been surveying and taking soundings of the river here for two months past. It is affirmed on official authority that the contract for grading a track from a point opposite Alton down the west shore of the Mississippi into St. Louis has been let to a construction company of St. Louis.

SOUTHWEST.—Existing Roads.

Kansas City, Fort Scott & Memphis.—It is stated that the officers of this company are examining the route of the extension from Springfield, Mo., to Little Rock, Ark., preparatory to commencing work.

Missouri Pacific.—A press dispatch says: The Missouri Pacific is now rapidly extending its line from Joplin, Mo., to Bald Knob, Ark., where it will connect with the Iron Mountain and make a direct line to Memphis. It has been the intention of the road to make this extension for some time, and a line has been surveyed from Carthage, Mo., across the northern part of Arkansas. The plans now, however, have been changed, and 10 miles of the road have been built from Joplin. A large force of graders and laborers is at work on the line, as is also a large corps of engineers. At Joplin work has been commenced on a $10,000 passenger depot. The extension is built through the mines south of Joplin to Grand Falls on the Shoal Creek. These falls will furnish 3,500 HP. for milling purposes and the site is owned by the Missouri, Kansas & Texas Trust Co. At Grand Falls the extension will branch, one part going to Memphis, Tenn., and one to Chetopa, Kan., on the line of the Missouri, Kansas & Texas R. R. This will make a direct road from Joplin through to Texas and Colorado. A Missouri Pacific extension from Joplin to Windsor, Mo., has been made, and will be opened for traffic in a few days.

Kansas City Terminal & Bridge Co.—This company has mortgaged its property to the Central Trust Co., of New York City, for $1,500,000. The proceeds were to be used in extending the belt line.

Projects and Surveys.

Omaha, Kansas Central & Galveston.—The surveys for this road are making good progress. It is expected that the engineers will reach Oklahama City, Ind. Ter., in a few days.

ROCKY MT. AND PACIFIC.—Existing Roads.

Northern Pacific.—The Tacoma, Olympia & Grays' Harbor R. R. has been completed and opened for traffic from Centralia, Wash., to Montesano. From Montesano to Acosta, Wash., the grading has been completed and the bridgework is making rapid progress.—Surveys are reported in progress from Snohomish, Wash., to a connection with the Spokane Falls & Northern R. R.—Work has been suspended on the Seattle Belt Line.—Surveys are in progress for a line from Grand Coulee to the Columbia River.—It is stated that the company contemplates spending over $4,000,000 in improvements during this year. About $1,500,000 will be spent in Washington, of which $915,000 will go to the Pacific division and $653,000 to the Cascade division. Of the sum to be expended on the Pacific division, $340,000 will be in trackwork of almost every description; $275,000 for filling and renewing bridges; $95,000 for new buildings and improvements of old ones, and $74,000 for right-of-way work. The improvements at Puyallup in the way of new yards, station buildings and depot will cost about $65,600. The proposed double track between Meeker and Tacoma, it is estimated, will cost $148,478.

Denver & Rio Grande.—A press dispatch says: The Denver & Rio Grande Co. has had surveyors for some time locating an air line directly west from Denver to Red Cliff, and there is renewed talk of an alleged determination by the company to build straight across the country 120 miles, instead of continuing around via Pueblo, Salida and Leadville to Red Cliff, a distance of 300 miles, with 180 miles saved. The route lies through Golden to Georgetown and the Brick Pomeroy tunnel, or by tunnel under Berthoud Pass to Middle Park and along the headwaters of the Grande. There is also talk of building west from Minturn, the first station west of Red Cliff, over the divide, to the headwaters of the White River, and thence directly west to Utah.

Great Northern.—Porter Bros., of Duluth, Minn., have the contract for the bridge building on the extension to the Pacific coast.

Union Pacific.—A dispatch from Tacoma, Wash., says that work will commence on the Portland & Puget Sound R. R. May 15. The route is from Portland, Ore., to Seattle, Wash., 185 miles. A large part of the grading has been completed.

Projects and Surveys.

Gualala River.—This company has been chartered in California to succeed to the property and franchises of the Gualala Mill Co., now operating about 5 miles of railway in Mendocino Co., and with power to construct additional mileage of standard-gage railway. The road will run from Bowen's Landing, Mendocino Co., south along the Gualala River through the counties of Sonoma and Mendocino, with a branch along the Gualala River to its source. Other branches will be built to the sources of Pepperwood Creek, Rock Pile Creek, Buckeye Creek, and the Wheatfield fork of the Gualala River. The estimated total length is 103 miles. S. H. Harmon, Gualala Cal., Secretary.

Oregon.—A citizens' meeting was recently held at Marquam, Ore., to consider the construction of a railway from Down's Station, on the Oregonian Ry., to a point near Jack's Bridge, on Butte Creek, five miles. R. H. Scott, Marquam, Ore.

Washington.—Surveys are in progress for a railway from Nisqually City, Wash., to the headwaters of the Nisqually River.—A company is being organized to build a railway from Hoquiam, Wash., up the Hoquiam River to Quimault Lake.

CITY TRANSIT.

Electric Railways.—New plants or extensions of existing systems are reported as probable in the following places: Mobile, Ala.; Clinton, Mass.; Augusta, Me.; Lynn, Mass., address the Lynn Belt Line Street Ry.; Portland, Ore., address the Multnomah Street Ry.; Covington, Ky., running to Ludlow; between Graham and Buckington, N. C.; Denver, Colo., address the University Park Ry. & Electric Co.; Elgin, Ill., address the City Ry.; Fall River, Mass., address the Globe Street Ry.; Vernon, Tex.; Seattle, Wash., address the Valley St. Electric Ry.; Buffalo, N. Y., address C. B. Hill.

Brooklyn, N. Y.—The Prospect Park & Flatbush R. R. has been leased to the Coney Island & Brooklyn R. R. By the consolidation it is hoped that the time from Flatbush to New York will be shortened by 15 minutes.

Newark, N. J.—A local newspaper states that an electric, and not a cable, railway will be built on South Orange Ave. by J. and A. Radel.

Braddock, Pa.—It is reported that the Braddock Electric Street Ry. will begin work in the spring on a line from Swissvale through Braddock to Wilkins.

Allentown, Pa.—The Allentown Passenger Ry. has been sold to the Industrial Improvement Co. of Boston, Mass., which, it is said, will greatly extend the lines to Bethlehem, and operate the system by electricity.

Winston, N. C.—The Winston Electric Light & Motive Power Co. and the Winston-Salem Street Ry. have consolidated under the name of the Winston-Salem Ry. & Electric Co. General Manager, H. S. Cooper.

Charleston, S. C.—At a meeting of the recently incorporated West End Ry., Geo. B. Edwards was elected President, M. Kelly Vice-President and K. S. Tupper Secretary and Treasurer. The directors decided to apply soon to the City Council for a franchise.

Athens, Ga.—The Athens Street Ry. will be equipped with Wenstrom apparatus by Chadbourne, Hazelton & Co., Philadelphia.

Birmingham, Ala.—The Birmingham Traction Co. will probably build a number of new lines soon. M. Verner, General Manager of the company, will superintend the work.

Oxford, Ala.—D. B. Lacy has secured the contract to build the Anniston extension of the Oxford Lake line.

Jacksonville, Fla.—The Jacksonville Street Ry. has applied to the City Council for authority to operate its lines by electricity.

Knoxville, Tenn.—The City Council has received a petition from Charles McNabb for right of way for a new electric line, the Knoxville & Cherokee Street Ry. Capt. H. H. Taylor has filed a similar petition for another new company, the Beaumont Street Ry.

Windsor, Mich.—The Detroit *Free Press* states that W. C. Turner, of Detroit, has bought the Windsor & Sandwich Street Car Ry. system and will introduce electricity.

Grand Rapids, Mich.—It is reported that all the street railways in this city have been bought by a syndicate, which will change some 36 miles into electric lines.

Sioux City, S. D.—It is reported that the Rapid Transit Ry. has promised to make improvements on its lines costing some $30,000.

Spokane Falls, Wash.—It is reported that the Spokane Street Ry. will be equipped with an electric system as soon as a proper franchise can be secured.

Seattle, Wash.—All the stockholders of the Seattle Electric Ry. & Power Co. have agreed to exchange their stock for that of the Seattle Consolidated Street Ry., which will hereafter operate the electric system.

Guernsey, Channel Islands.—The Guernsey Ry., Wm. Gumbley, Secretary, will receive bids until Feb. 28 for the alterations and plant necessary to convert the present steam tramway, 2¼ miles long, into an overhead trolley line.

Pole Railway.—*Blacksburg, S. C.*—J. W. Whisnant wishes bids for furnishing cars for a pole road.

Cable Railway.—*San Francisco, Cal.*—The stockholders of the Presidio & Ferris Ry. will meet April 17 to vote on issuing $250,000 of bonds for improvements. The cable line will probably be extended and lever grips substituted for the old screw type now in use.

Elevated Railway.—*Philadelphia, Pa.*—Mayor Fitler has signed the Market St. Elevated Railway bill. The road is to be 7 miles long and completed in 2 years. The contract must be awarded in 2 months.

Chicago, Ill.—F. J. McCain & Bro. have the contract for constructing a part of the South Side Elevated Ry., 2¼ miles of which are already erected and the track laid.

Horse Railways.—New lines are reported as probable in the following places: Eufaula, Ala.; Arcadia, Fla., address F. C. Peters; Wenona, Ga., address Futz, Zuber & Co.; Albina, Ore., address Dr. L. M. Davis; Staunton, Va., address the City Street Car Co.

Lowell, Mass.—The directors of the Lowell Horse Ry. and the Lowell & Dracut Street Ry. voted to submit plans to the stockholders for a consolidation of the two companies.

Santa Rosa, Cal.—It is reported that a company is being organized with a capital stock of $50,000 to extend the South Park Street Ry. to White Sulphur Springs, a distance of 2 miles.

Dummy Railways.—*New Orleans, La.*—An ordinance authorizing the New Orleans City & Lake R. R. to extend its lines has been introduced in the city council.

San Bernardino, Cal.—It is reported that the San Bernardino, Arrowhead & Waterman Motor Ry. will make a 2 mile extension.

New Companies.—Bridgeton, N. J., Electric Street Ry.; capital stock, $50,000; incorporators, J. R. Hoagland, B. Hancock, F. R. Fithian. Valley Street Ry., Seattle, Wash.; capital stock, $125,000; incorporators, J. Horton, J. Lines, I. W. Adams and others. Denver Syndicate Street R. R., East St. Louis, Ill.; capital stock, $250,000; incorporatars, J. F. McCasland, J. Scherrer, I. B. Porter.

HIGHWAYS.

New York.—A circular has been issued, signed by G. Stanton Floyd Jones, Massapequa, L. I., announcing that about $300 has been subscribed and is offered in money prizes to the overseers of roads in the townships of Babylon, Oyster Bay and Hempstead who shall maintain in the best condition during the months of June, July, August and September, 1891, the turnpike or south road in their respective districts between Freeport and Argyle Brook in Babylon. Elbert Floyd-Jones, of South Oyster Bay; H. H. Cammann, of Merrick; E. B. Sutton, of Babylon, and T. F. Neville, of Breslau, will be the inspectors and judges of the roads.

Washington.—The citizens of Lewis Co. have requested their representatives in the state legislature to endeavor to secure the repeal of the road law which was passed at the last session. They complain that it works a hardship upon the farmers of the vicinity and the state in general in compelling them to pay the road tax in cash, instead of being allowed to work out the same on the roads; and that it gives the county commissioners more power than is needful, thereby creating an unnecessary expense and depriving the road overseer of using his own discretion and judgment in the manner of maintaining the roads.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Tonawanda, N. Y.*—The bill appropriating $35,000 for a bridge across the Erie Canal at this place has passed the New York Assembly.

Parkersburg, W. Va.—A company will probably be organized to construct a bridge at George St.

Alton, Ill.—It is announced that the Chicago, Burling-

ton & Quincy R. R. will build a bridge across the Mississippi River at this point.

Los Angeles, Cal.—The Southern Pacific Co. has submitted plans to the City Engineer of Los Angeles for two large bridges, which it proposed to build at once. The largest one is to cross the Los Angeles River, north of the Santa Fé's bridge, at the base of the bluff, by the reservoir at Elysian Park. This will be a double-track steel "skew" bridge of two spans of 156.4 ft. each. The other bridge will be of the same type and pattern, the only difference being that it will be a single track. It will also consist of but two spans, of 166.8 ft. This will be placed at the end of Mission St., on the Yuma Division of the road. They will rest on iron cylinders 7 ft. in diameter, that will be sunk 50 ft. below the bottom of the river and then filled with concrete. The bridges will cost the Southern Pacific about $100,000.

WATER-WORKS.

NEW ENGLAND.

Townshend, Vt.—H. B. Kenyon informs us that he is one of a committee of three appointed to report to the citizens on the construction of works to be owned by a company. Population, 300.

Easthampton, Mass.—John Mayhew informs us that the increase to the water supply will consist of conducting to the reservoir water from additional springs.

Holbrook and Randolph, Mass.—It is reported that a new pump will be bought by these towns for the joint works.

Lynn, Mass.—Steps are being taken for the issuance of $150,000 water bonds.

Farmington, Conn.—Address T. L. Porter regarding proposed works.

Meriden, Conn.—The Meriden Brittania Co. has sent the following:

The Meriden Brittania and the Bradley & Hubbard Cos. are constructing a 5,000,000-gall. reservoir about three miles from and 177 ft. above the works of the former. The dam will be 14 ft. high.

MIDDLE.

Niagara Falls, N. Y.—Benjamin Rhodes, Secretary of the Niagara Falls Water Co., has sent the following:

The Cataract Construction has bought nearly all the stock of the above-named company and will probably improve the works. J. B. Gaskill is President and A. J. Porter Secretary of the Cataract Co.

Syracuse, N. Y.—Investigations for a storage reservoir site are in progress under the direction of the city.

Walden, N. Y.—The following is from E. A. Nichols, Village Clerk:

No definite action regarding works has been taken, further than to appoint a special committee from the Village Trustees to investigate and report from time to time. A private company applied for a franchise, but this was not granted. The people are not yet convinced of the necessity of having water-works.

Vineland, N. J.—C. Keighley informs us that the incorporation of the Vineland Water-Works Co., noted last week, relates to his own works, and that no extensions will be made at present.

Bridgeport, Pa.—L. D. Buckley has sent the following: The main and hydrants are in place, but the pumping station has not been built. The franchise has passed into the hands of P. D. Wannes, Reading, and it is expected that the works will be completed in the spring.

SOUTHERN.

New Berne, N. C.—An investigating committee has recommended the construction of works at an estimated cost of $60,000.

Carrollton, Ga.—A franchise may be given to a company. D. G. Jackson is Clerk of the City Council.

Port Gibson, Miss.—The citizens have expressed themselves as in favor of water-works, and will advertise for plans and specifications. The supply will probably be from an artesian well.

NORTH CENTRAL.

La Fayette, Ind.—The West La Fayette Water Co. has been incorporated; capital stock, $25,000.

Downer's Grove, Ill.—D. Simonson informs us that works may be built this spring by the town, the supply to be pumped from tube wells. Population, about 1,500.

Kilbourne City, Wis.—P. M. Marshall. Superintendent, informs us that the water supply, which is from wells, is somewhat limited, and that an additional supply is under consideration.

NORTH WESTERN.

Avoca, Ia.—The following is from J. T. Hazen, Chief Fire Department:

Bonds have been provided to pay for works costing about $15,000, to be owned by the village. It is expected that contracts will be let soon, and that construction will be started as soon as the frost is out of the ground. The supply will be pumped from driven wells to a stand-pipe. A. McCandless is Village Recorder. Population, 1,700.

SOUTHWESTERN.

Arkadelphia, Ark.—The following is from E. N. Maxwell, Texarkana:

The Arkadelphia Water & Light Co. propose to let contracts for works about March 1. Water will be pumped to a stand-pipe. M. P. Hillyer, Topeka, Kan., is President. Estimated cost, $70,000. Population, 5,000.

Boulder, Col.—The New Anderson Ditch Co. has been incorporated to build a ditch and reservoir; capital stock, $5,000.

Texarkana, Tex.—Henry Mendels, City Secretary informs us that the works were sold by the city in November to W. L. Whittaker, who sold them recently to a Mr. Hylyer of Kansas.

PACIFIC.

Centralia, Wash.—The Centralia Water Co. informs us that their works will be in operation Mar. 1. Water will be pumped from a well to a reservoir. There are 6¼ miles of mains and 25 hydrants.

Ocosta, Wash.—The Northern Pacific R. R. Co. will put in a large water tank.

East Portland, Ore.—J. A. Newell, Secretary, has sent the following:

The East Side Water Co. will have works in operation Mar. 1, though they will not be completed before July 1. The supply is from artesian wells. Direct pumping will be used until the stand-pipe is finished. The city will purchase the works when finally completed.

San Francisco, Cal.—A move is on foot to authorize the city to buy or build works.

CANADA.

Pictou, N. S.—A resident informs us that a meeting will soon be held to decide whether works will be built. The works projected some time ago were not built.

ARTESIAN WELLS.

Florence, S. C.—E. W. Lloyd, Clerk, informs us that C. L. Parker will soon begin to sink a well for the city.

Marion, S. C.—A well is projected.

Dallas, Tex.—It is reported that the city has contracted with F. O. Brown for the sinking of a well.

IRRIGATION.

Candler and Orange City, Fla.—It is reported that A. D. Moore is putting in an irrigation plant for his orange grove at Candler, and that a similar plant will be put for groves at Orange City.

SEWERAGE AND MUNICIPAL.

Sewers.—*Brooklyn, N. Y.*—The Bay Ridge and Fort Hamilton Citizens' Association has been discussing the question of sewerage for these places and New Utrecht, and is in favor of private corporations being allowed to contract for building sewers.

Newark, N. J.—An application has been made by the City Counsel to have a new set of commissioners appointed to make a new assessment for the intercepting sewer.

Orange, N. J.—The sewerage system is to be built from plans by C. P. Bassett, of Newark; and a double system is provided for, one for the sewage proper and the other for the drainage and storm water. The outlet is to be by the way of the Second River to the Passaic at Belleville. The cost of the entire system will be in the neighborhood of $500,000. The Common Council will introduce an ordinance, which has already been prepared. It is estimated that it will require 2 years for the system to be completed.

Baltimore, Md.—An appropriation of $38,600 has been made for the Read St. sewer. Mr. Menies Cohen, M. Am. Soc. C. E., recently read a paper before the Taxpayers' Association on "Drainage and Its Relation to the Value of Real Estate in the City of Baltimore." He advocated a general system for storm water and sewage, and thought that the present expenditures for sewer purposes should be checked.

Roanoke, Va.—The plans prepared by Mr. Rudolph Hering for a system of sewerage have been submitted to the City Council. The intercepting sewer is to be 6 ft. in diameter, lined with brick in cement; it will be in places 60 ft. below the surface.

Salem, O.—Plans for a system of sewers are being prepared by Edward D. Bolton, Consulting Engineer, 44 Broadway, New York City. Construction will be commenced shortly.

Los Angeles, Cal.—The question of a better method of disposing of the sewage is under consideration, and a meeting has been held between the City Council and the owners of property between the city and the ocean. It is thought that, while the sewage shold be used for irrigating purposes, there should be a connection to the ocean, so that the surplus water could be carried off during the rainy season.

Streets.—*Central Falls, R. I.*—It is proposed to issue $300,000 in bonds for street and other improvements.

Pittsburg, Pa.—Superintendent Browne, of the Engineering Bureau, in his report, states that cobblestone paving should be replaced by Ligonier or granite blocks or asphalt, and that gas, water and sewer connections should be made before a street is paved; 5½ miles of paving were completed last year.

Morristown, Tenn.—It is proposed to issue bonds for $50,000, of which $30,000 will be for street improvements.

Newberne, N. C.—It is proposed to issue bonds for $35,000 for street improvements.

Athens, Ga.—It is proposed to issue bonds of $200,000 for street and other improvements.

Cincinnati, O.—G. C. Sconce has a contract for vitrified brick paving on Woodburn Ave.

Detroit, Mich.—It is proposed to issue bonds for $1,150,000, of which $250,000 would be for sewers and $500,000 for streets. The Board of Public Works has been directed to advertise for proposals for paving.

Lighting.—*Cincinnati, O.*—The Committee on Light has received the following bids for gasoline lighting for 5 years: Sun Vapor Co., Canton, O., $21.50 per lamp per year all night, moonlight $17.50, iron posts $2 each, wooden posts $1.75; Frank Fogerty, $19.85, $16.75, $1.90, $1.80; Fred Switzer, $17.60, $16, $2, $1.80; Geo. W. Martin, $17.20, $14, $1.85, $1.25. The contract was awarded to F. Switzer.

Holly Springs, Miss.—The Sun Vapor Lighting Co., of Canton, O., has a contract for lighting the streets with 40 lights of 16 c. p. each, the lights to burn 20 nights per month.

ELECTRICAL.

Electric Light.—New plants or extensions of existing systems are reported as probable in the following cities: Salem, Ind., address E. W. Menaugh, Upper Alton, Mo.; Superior, Wis., address the Mayor; Monson, Me; Palestine, Tex.; Martinsville, Va.; Indiana, Pa., address W. B. Kline; Lake Charles, La., address J. A. Landry & Co.; Wallingford, Conn.; Spring Valley, Minn.; St. Catharines, Ont.; Murfreesboro, Tenn., address the City Illuminating Co.; Monbo, N. C., address the Long Island Cotton Mills Co.; Durham, N. C.; De Funiak Springs, Fla.; Greeneville, Tenn.; Waynesburg, Md.; Charleston, W. Va., address the Charleston Gas Light Co.; Ashland, Va.; Methuen, Mass; Delavan, Ill.; Cameron, Mo.

Salem, N. Y.—The Board of Trustees has received an offer to furnish incandescent lamps to the town at $840 to $1,000 per annum and arc lights at from $1,000 to $1,200. The matter is still under discussion.

Perth Amboy, N. J.—A town committee has been appointed to investigate the municipal lighting plants.

Lancaster, Pa.—The Edison Electric Illuminating Co. has offered to light the city with 2,000 c. p. lights for one year at 34 cts. per light or at 33 cts. on a 3-year contract.

Union City, Ind.—The Union City Electric Light & Power Co. desires bids on an incandescent plant.

Springfield, Ill.—A new electric light company is being formed in this city. The promoters of the company propose to supply lights burning until 11 P. M. at $5 per light per month. L. Sparks can give further information.

Elmhurst, Ill.—The Board of Trustees has refused to grant franchises to private electric light companies, and proposes to erect its own plant, the village being bonded for $15,000 for the purpose.

Windsor, Mich.—The Reliance Electric Lighting Co. is said to be organizing a stock company to operate a private lighting plant.

Victoria, B. C.—There is some talk of the city putting in a municipal plant to cost $50,000.

NEW COMPANIES.—Gas Engineering Co., Newark, N. J.; capital stock, $100,000; incorporators, H. Pettibone, of Hartford, Conn.; J. C. S. Tabor, of New York; W. H. Townsend, of Brooklyn. Bloomsdale, Pa., Electric Light & Power Co.; capital stock, $25,000; Secretary, L. E. Waller, Jr. Darlington, S. C., Light, Water & Power Co.; W. F. Dargan, President. Arkadelphia, Ark., Water & Light Co.; capital stock, $50,000; incorporators, M. P. Hillyer, R. A. Holden, E. N. Maxwell. Woodberry & Belt Electric Light & Power Co., Woodberry, Md.; capital stock, $100,000; J. E. Hooper, President. Wisconsin Electric Light & Power Co., Milwaukee, Wis.; capital stock, $50,000. Salem, Ind., Electric Light & Power Co.; capital stock, $15,000; directors, A. J. Parker, L. W. Sinclair, L. Dennis and others. Cincinnati Edison Electric Co., Cincinnati, O.; capital stock, $1,000,000. Wellwood, N. J., Electric Co.; capital stock, $40,000; incorporators, E. Morris, W. Longstreth, J. F. Johns.

CONTRACTING.

Iron Work and Dam.—The contract for iron work for anchorages and fixed parts of movable dams Nos. 7 and 8, of the Great Kanawha River improvement, has been awarded by Col. Wm. P. Craighill, U. S. Engineer Office, Charleston, W. Va., to the Russell Wheel & Foundry Co., of Detroit, Mich. The prices were 3.3 cts. per lb. for wrought iron and 2.45 cts. per lb. for cast iron; total, $11,750. All bids for dam No. 8 were rejected as being too high.

Masonry.—The contract for the masonry of the 800-ft. lock at the St. Mary's Falls Canal has been awarded by Col. O. M. Poe, U. S. Engineer Office, Detroit, Mich., to Hughes Bros & Bangs, of Syracuse, N. Y., at an aggregate price of $1,268,500. The detail prices of the several bids were given on p. 144.

Street Work.—*Duluth, Minn.*—Contracts have been awarded by Mr. Wm. B. Fuller, City Engineer, as follows: Paving Second St.: Robt. L. Wilson; earth and rock excavation, 45 cts. and $1.50 per cu. yd.; earth and rock in foundation, 20 cts. and $1 per cu. yd.; mortar rubble masonry, $4 per cu. yd.; cedar block pavement on telford, $1.40 per sq. yd.; Kettle River sandstone curbing, 90 cts. per ft.; timber, $15 per 1,000 ft. B. M.; castings, 3½ cts. per lb.; relaying sidewalks, 10 cts. per lin. ft.; total, $92,614. Paving Garfield Ave.: Thos. Reilly; earth excavation, 22 cts. per cu. yd.; borrow, 35 cts. per cu. yd.; cedar block paving, 93 cts. per sq. yd.; Berea sandstone curbing, 60 cts. per lin. ft.; oak timber, $31 per 1,000 ft. B. M.; mortar rubble masonry, $5.25 per cu. yd.; earth excavation, 15 cts. per cu. yd.; slabs, $2.50 per cord; clearing and grubbing, $100; castings, 3 cts. per lb.; relaying sidewalk, 15 cts. per lin. ft.; total, $57,522.

Sewers.—*Boston, Mass.*—The following proposals were received Feb. 14 by the Metropolitan Sewerage Commission for main sewers: Section E, Brighton; Section F,

Newton and Watertown; Section G, Newton. The bidders were as follows: A, John Cavanagh, Boston; B, James F. Gillen, Brooklyn, N. Y.; C, National Construction Co., Boston; D, James Deehan, Philadelphia, Pa.; E, O. P. Roberts, Cambridge, Mass.; F, Jones and Meehan, Jamaica Plain, Mass.; G, Collins & Ham, Boston; H, Dennis O'Connell, Dorchester, Mass.; I, Geo. S. Stuart, Newton, Mass.; J, Collins, Fitzgerald & Co., Somerville, Mass.; K, J. F. Callanan and C. G. Craib.

Section E.	Earth excavating and refill.	Earth excavating and refill.	Rock excavation.	Brick masonry, American.	Brick masonry, Portland.	Concrete masonry, American.	Concrete masonry, Portland.	River wall masonry.	Spruce lumber in place.	Spruce piles driven.	Earth excav. and refill, outside of trench.	Totals.
	lin. ft.	lin. ft.	cu.yds.	cu.yds.	cu.yds.	cu.yds.	cu.yds.	cu.yds.	M. ft. B. M.	lin. ft.	cu.yds.	
	8,000		100	2,100	1,200	560	230		100	5,000	500	
A	$9.50	.....	$4.00	$14.00	$15.75	$7.00	$8.00	.....	$27.00	$0.17	$1.25	$138,835
B	9.00	.....	1.00	12.00	15.25	6.00	8.75	.....	30.00	0.35	0.65	129,647
C	7.25	.....	5.00	14.73	16.25	5.65	7.63	.....	35.00	0.18	1.25	123,295
D	6.00	.....	2.00	14.00	16.00	7.00	9.00	.....	23.00	0.50	0.80	112,190
E	5.55	.....	3.50	14.00	15.05	5.55	6.90	.....	28.60	0.18	1.00	105,305
F	4.23	.....	0.50	12.00	13.50	4.40	6.00	.....	26.00	0.15	0.50	86,334
	57,000	2,000										
Section F.	57 × 50 ins.	53 × 47 ins.	100	2,200	950	650	250	225	90	1,000	500	
G	$11.00	$10.00	$4.00	$14.50	$17.00	$6.00	$7.50	$20.00	$30.00	$0.30	$0.75	$144,800
H	8.00	8.00	1.00	12.00	15.25	6.00	8.75	18.50	30.00	0.35	0.65	116,212
I	5.50	5.75	4.75	15.50	16.50	6.50	7.00	20.00	30.00	0.30	1.00	107,075
D	6.00	6.00	2.00	14.00	16.00	7.00	9.00	14.00	23.00	0.50	0.80	105,320
F	3.60	3.50	5.00	13.00	14.50	4.40	6.00	14.00	26.00	0.20	0.50	80,695
	1,250	6,045										
Section G.	53 × 47 ins.	48 × 42 ins.	50	1800	850	400	225		70	500	500	
B	$8.60	$8.60	$1.00	$12.00	$15.25	$6.00	$8.75	.....	$30.00	$0.35	$0.65	$104,318
I	8.10	5.62	5.16	15.32	16.87	5.57	7.12	.....	33.00	0.17½	1.00	92,998
D	6.00	6.00	2.00	14.00	16.00	7.00	9.00	.....	23.00	0.60	0.80	89,755
E	5.80	5.80	3.50	14.00	15.05	5.55	6.90	.....	28.00	0.18	1.00	86,801
J	5.75	5.75	5.00	13.25	15.50	5.00	6.00	.....	24.50	0.20	0.80	84,786
H	8.00	3.97	3.00	13.75	14.50	4.75	5.50	.....	30.00	0.30	1.60	77,111
K	5.00	3.50	5.00	13.50	14.50	4.25	6.00	.....	24.00	0.15	0.80	69,487
F	4.46	3.25	0.50	12.00	13.50	4.40	6.00	.....	26.00	0.20	0.50	63,601

PROPOSALS OPEN.

Ditch.—Lower Scioto ditch, in Hardin Co., O. About 297,395 cu. yds. of excavation of common clay, blue clay and gravel, with probably quicksand in places; prices estimated at 10 to 20 cts. per cu. yd.; total estimated cost $36,882; estimate for moving 3 iron bridges, $100 each. S. F. Moore, Civil Engineer, Kenton, O. Feb. 28.

Bridges.—*Kansas City, Mo.*—Three iron bridges, 40, 60 and 80 ft. span; 2 wooden bridges, 40 ft. span. F. J. O'Flaherty, County Surveyor, Water-Works Building. March 7.

Masonry.—*Minneapolis, Minn.*—For piers and abutments of new bridge across the Mississippi. The Chief Engineer, Great Northern Ry., St. Paul, Minn.

Dikes.—Pile and stone dike at Bulkhead Bar. Major C. W. Raymond, U. S. Engineer Office, Philadelphia, Pa. Feb. 23.

Pile and stone dike at Livingston Point, Ky. Lt.-Col. J. W. Barlow, U. S. Engineer Office, Nashville, Tenn. March 11.

Pile Work.—*Toledo, O.*—About 1,800 lin. ft. of pile protection work at Toledo Harbor. Major L. Cooper Overman, U. S. Engineer Office, Cleveland, O. March 11.

Street Work.—*New York, N. Y.*—Regulating granite block paving on concrete and telford foundation; 20,000 cu. yds. of clean, sharp sand; 12,000 ft. of bridge stone; bricks, cement, sand, sewer pipe, timber, manhole heads and covers, step irons, etc. Department of Public Works, 31 Chambers St. Feb. 16,

Steel Pipe.—*East Riverside, Cal.*—Furnishing, trenching, laying and backfilling about 39,000 ft. of 30-in. steel pipe, with air valves, blow-offs, stop valves, etc. East Riverside Irrigation District. March 3.

Sea Wall.—*San Francisco, Cal.*—About 1,476 piles and 770,000 ft. B. M. of timber in foundation, 2,423 cu. yds. of concrete wall, 1,625 tons of rough stone footwall and 40,000 cu. yds. of sand for embankment. Harbor Commissioners, 10 California St. March 5.

MANUFACTURING AND TECHNICAL.

Locomotives.—The Schenectady Locomotive Works, of Schenectady, N. Y., have delivered 2 engines to the Atchison, Topeka & Santa Fé; a 50-ton mogul with 55 in. drivers, to the Bennington & Rutland, and a freight engine to the Fitchburg. They are building a mogul engine for the Bennington & Rutland. The Grant Locomotive Co. will build its works at Chicago this spring; they will have a capacity for 250 engines per year.

Cars.—The Northern Car Co., of Minneapolis, Minn., has enlarged its plant; it is building electric cars for Bellingham Bay, Wash.; Anaconda, Mont., and Helena, Mont.; also suburban cars for the Sioux City Rapid Transit Co., and the Sioux City & Highland Park Ry. J. G. Brill & Co., of Philadelphia, Pa., have built a cable car for the Third Ave. R. R., New York City; it is 30 ft. long, 8 ft. wide, and seats 36 passengers. The Barney & Smith Mfg. Co., of Dayton, O., is building 12 passenger cars for the Chicago, St. Paul & Kansas City; they are 66 ft. long, 60 ft. over the body, and are carried on six-wheel trucks with 36-in. Krupp tired wheels; they carry 64 passengers each; also 48 cars for the New York, Lake Erie & Western. The Pullman Palace Car Co., of Chicago, Ill., has built 5 vestibuled sleeping cars for the New York, Lake Erie & Western, and is building passenger cars for the Chicago & Northwestern. The Philadelphia & Reading has placed orders for 3,000 coal cars, 1,000 gondolas, 1,000 box cars and 50 stock cars; all will be equipped with automatic couplers and air brakes. The Georgia Rolling Stock Co., of Macon, Ga., has been organized with a capital stock of $1,000,000. The Krehbiel Palace Car Co., of Chicago, Ill., has been incorporated by F. L. Wear, Benj. F. Methven and Wm. Prescott; capital stock, $2,500,000. The company has an improved form of vestibule for palace cars, which takes the place of the ordinary platforms and hoods.

Electric Headlights.—The Cincinnati, Hamilton & Dayton is equipping its freight engines with the National electric headlight, which is already in use on the passenger engines.

Snow Plow.—The Northern Pacific has received two rotary snow plows from the Leslie Mfg. Co., of Paterson, N. J.

Railway Crossing.—The Union Switch & Signal Co. will put in a complete system of interlocking signals, switches, derailing switches, etc., at the Stewart Ave. crossing, Chicago. There will be 60 levers, operating the plant by electricity and compressed air.

Railway Shops.—The Baltimore & Ohio has purchased a site at Cumberland, Md., for machine shops, a roundhouse and extensive yards.

Car Ventilator.—A new form of exhaust ventilator, patented by R. M. Pancoast, of Camden, N. J., has been tried on a B. & O. car and is being tested by the Pennsylvania R. R. testing department at Altoona, Pa.

The Industrial Works, Bay City, Mich., have built 15-ton wrecking cranes and cars for the Nicaragua Canal Co. and the West Virginia Central R. R. The Lehigh Valley R. R. is erecting one of their 20-ton steel transfer cranes at Jersey City, N. J., and the Michigan Central R. R. has a traveling crane at its Jackson shops. They have sent a standard steam shovel to the Mexican Ry., a pile-driver to the Sioux City & Northern R. R., a 10-ton power traveling crane for the Marinette Iron Works at Duluth, and 2 steam jib cranes of 10 and 25 tons capacity for the E. P. Allis Co., of Milwaukee. For this company they are also building a steam track crane. A portable rail sawing plant is being built for the Chicago & Grand Trunk Ry. It consists of a steel car, boiler and high speed engine, cutting-off saw, double drill, hydraulic straightener and machinery for handling the rail. Two 70-ft. electric transfer tables are being built for the Union Pacific Ry. and the Denver Union Ry. & Terminal Co. They have a large contract for dredging plant to be used on government work on the lakes.

The Grand Rapids Brick Co., Grand Rapids, Mich., has established a plant for the manufacture of paving brick from a clay bed 14 ft. deep, near the city. Brick made of this clay has been in use on streets in Grand Rapids for 1½ years. Secretary, W. O. Hughart, Jr.

The American Filter Co., of Chicago, Ill., has a contract for increasing the capacity of the filter plant at Mt. Clemens, Mich., to 1,000,000 galls. per day; a 300,000-gall. plant was put in by this company 2 years ago. It is also putting in plants at Davenport, Ia., and Independence, Kan., of 7,500,000 and 500,000 galls. capacity.

The Lidgerwood Mfg. Co., New York, reports sales of 1,105 engines and 583 boilers during 1890. The company controls patents by M. W. Locke, J. S. Miller and M. C. Harris for suspended cableways, and arrangements have been made to take care of a large increase in the cableway business this year.

The Bucyrus Steam Shovel & Dredge Co., of Bucyrus, O., has sold 2 large shovels to the Cleveland Iron Mining Co., and 1 to the Lake Angeline Mining Co. These are for handling hard and soft ore, and have a capacity of 5 tons per min. It is claimed that they will load ore at about one-third the expense of hand labor.

Fuel Gas Furnace.—The Hutchinson fuel gas furnace, manufactured by W. S. Hutchinson, of Chicago, is claimed to effect a saving of 10 to 40% of fuel.

The National Hollow Brake Beam Co., of Chicago, Ill., is increasing the capacity of its works.

The Chicago Bridge & Forge Co., of Chicago, Ill., has contracts for the Taylor St. viaduct and a viaduct in St. Paul, Minn., connecting the city with Dayton's Bluff.

T. J. McCain & Bro., of Chicago, Ill., have contracts for the erection of the Chicago South Side Elevated Ry., an incline 2,900 ft. long at Duluth, Minn., and the Hotel Chicago. The iron work is to be furnished by the Keystone Bridge Co., of Pittsburg, Pa.

The Interstate Engineering Co. has been organized in East St. Louis, Ill., President, L. G. Mickles; Vice-President, C. A. Van Borcke; Secretary, C. L. Weber; Treasurer, F. C. H. Arentz. The company has an office in the Real Estate Exchange, St. Louis, Mo.

The American Employers' Liability Insurance Co. is the latest organization in the field to protect employers of labor against claims for accidents to workmen, and to avoid the difficulties of lawsuits and the attendant trouble and expense. This company is made up of the employers themselves, and has the following officers: Jonathan H. Crane, President; John J. Tucker, Vice-President; James Browne, Treasurer, and John Macrae, Secretary and General Manager. The paid-up capital amounts to $150,000, and on this the stockholders limit their dividend to 6%; and of the net profits 75% are annually divided among the policy holders. As a result of the first fiscal year's business, the report of the company shows all claims paid and a return to the policy holders of a 20% rebate on the original premiums paid. The office of the company is at No. 9 Pine St., Astor Building, New York.

Machinery.—The Norwood Car Replacer Co., of Baltimore, Md., will erect a malleable iron plant, and wants estimates on the necessary machinery.

New Companies.—American Nut Lock Co., of St. Louis, Mo.; incorporators, John A. Inslee, F. A. Johann and J. A. Harrison; capital stock, $20,000. Queen City Mfg. Co., of East St. Louis, Ill.; to manufacture railway appliances and tools; incorporators, H. G. Weber, W. H. Hill and Paul W. Abt; capital stock, $100,000. Lake Steel & Iron Co., of Yorkville, S. C.; incorporators, E. Whitlock, Louis Stein and Samuel Proskaner; capital stock, $1,000,000. Chicago Investment & Construction Co., of Chicago, Ill.; incorporators, Hy. S. Waldron, Geo. W. Lewis and T. Armstrong; capital stock, $1,000,000. Southern Construction Co., of Chicago; incorporators, Geo. H. Toby, G. A. Whitkop and A. D. Eddly; capital stock, $500,000. Bates Iron & Steel Co., of Chicago; incorporators, J. C. Parkes, Jas. E. York and Wm. J. Leddell; capital stock, $100,000.

Metal Market Prices.—***Rails.***—New York: $29.50 to $30; old rails, $22 to $22.50 for iron and $20 for steel. Pittsburg: $26.50 to $27; old rails, $21.50 to $25 for iron, and $17.75 to $18 for steel. Chicago: $31 to $32.50; old rails, $23 to $23.25 for iron and $14.50 to $18.50 for steel.

Foundry Pig Iron.—New York: $15.75 to $17.50. Pittsburg: $14.75 to $16.50. Chicago: $14.50 to $16.

Track Materials.—New York: steel angle bars, 1.75 to 1.80 cts.; spikes, $1.90 to $1.95; track bolts, 2.75 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.9 to 2 cts. for iron or steel; iron or steel spikes, 2.1 cts.; iron track bolts, 2.8 cts. with square, and 2.9 cts. with hexagon nuts. Chicago: splice bars, 1.8 to 1.9 cts. for iron and 1.9 to 2 cts. for steel; spikes, 2 to 2.15 cts.; track bolts, 2.8 to 3 cts. with hexagon nuts.

Pipe.—Cast iron, $27 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.30 to 4.35 cts. Chicago, 4.15 to 4.20 cts. St. Louis, 4.30 cts.

Structural Material.—New York: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2 to 2.1 cts.; tees, 2.5 to 2.75 cts.; sheared iron plates, 2.05 to 2.25 cts.; steel plates, 2.05 to 2.15 cts. for tank, 2.35 to 2.6 cts. for shell, 2.6 to 2.7 cts. for flange, 3.75 to 4.25 cts. for firebox. Pittsburg: beams, 3.1 cts.; channels, 3.1 cts.; angles, 2.15 to 2.25 cts.; tees, 2.85 cts.; universal iron mill plates, 2.25 cts.; sheared steel bridge plates, 2.4 to 2.45 cts.; refined bars, 1.9 to 1.95 cts.; steel plates, 2.25 to 2.35 cts. for tank, 2.6 to 2.7 cts. for shell, 2.8 to 2.9 cts. for flange, 4.25 to 4.5 cts. for firebox. Chicago: beams, 3.2 cts.; channels 3.2 cts.; angles, 2.25 to 2.35 cts.; tees, 2.7 to 2.85 cts.; universal plates, 2.3 to 2.4 cts.; sheared plates, 2.5 to 2.6 cts. for iron and 2.6 to 2.7 cts. for steel; steel plates, 2.8 to 2.9 cts. for tank, 3.25 cts. for shell, 3.5 cts. for flange, 4.25 to 5.5 cts. for firebox; boiler rivets 4. to 25 cts.